Assessment of the relationship of palatal root tip of maxillary first molar with maxillary sinus floor in both coronal and sagittal section using computed tomography volumetric imaging (CBVI): A retrospective study

Dissertation Submitted To

BABU BANARASI DAS UNIVERSITY, LUCKNOW, UTTAR PRADESH

In the partial fulfillment of the requirement for the degree of

Master of Dental Surgery

In

Oral Medicine and Radiology

by

Dr. Priyanka Khanna

Under the guidance of

Dr. Priya Singh

Reader

DEPARTMENT OF ORAL MEDICINE AND RADIOLOGY

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, BBDU

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BATCH 2021-2024

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I hereby declare that this dissertation entitled **Assessment of the relationship of palatal root tip of maxillary first molar with maxillary sinus floor in both coronal and sagittal section using computed tomography volumetric imaging (CBVI): A retrospective study** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Priya Singh**, Reader and **Dr. Saurabh Srivastava**, Reader, Dept. of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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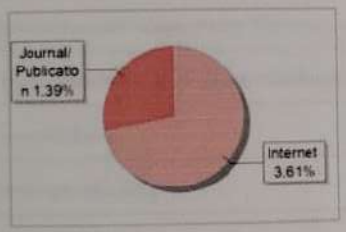

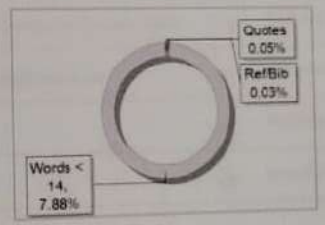

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“SUCCESS IS NOT FINAL; FAILURE IS NOT FATAL: IT IS THE COURAGE TO CONTINUE THAT COUNTS.”

— WINSTON CHURCHILL

Words cannot express when the heart is full of praise and gratitude. The accomplishment of this study could not have been possible without the constant guidance, support, and exhortation of my mentor and guide, **Dr. Priya Singh, Reader, Department of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow.** Her guidance has helped me at all times in completing this dissertation; with her profuse knowledge of the subject and intense involvement, the dissertation's success was achievable.

I extend my heartfelt gratitude to my co-guide, **Dr. Saurabh Srivastava, Reader, Department of Oral Medicine and Radiology, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow.** He has been an amalgam of wisdom and skill, and his reputation as an exceptional reviewer has helped me every step of the way as I finished this dissertation.

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knowledge and expertise, and her guidance has been invaluable to me as I completed this dissertation. **Dr. Puja Rai**, Senior Lecturer, has been discerning, insightful, and well-informed and instilled these qualities within us. **Dr. Abhishek Banerjee,** Senior Lecturer, has always been the flag barrier of Working hard and at the same time not forgetting to have fun. **Dr. Shweta Singh**, Senior Lecturer, has been easy-going throughout and motivating to stride higher and achieve the greatest.

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And last but not least, 'I thank the Almighty, the Most Gracious and the Most Merciful, for giving me the strength to grow Spiritually, Intellectually and Personally.'

Dr. Priyanka Khanna

Department of Oral Medicine and Radiology

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LIST OF ABBREVIATIONS

MS	Maxillary sinus
SPA	Sphenopalatine artery
CBCT/ CBVI	Cone beam computed tomography/ cone beam volumetric imaging
CT	Computed tomography
VD	Vertical distance
ALARA	As low as reasonably achievable
RR	Residual ridge height
RRW	Ridge bone density
BD	Bone density
MSA	Maxillary sinus angle
LWT	Lateral wall thickness
MT	Membrane thickness
SS	Sinus septa
PSAA	Posterior superior alveolar artery
CI	Cephalic index
MSF	Maxillary sinus floor
MCB	Maxillary cortical bone
MBR	Mesiobuccal roots
MSM	Maxillary sinus molar
MFM	Maxillary first molar
PR	Palatal root
PR	Palatal root
MB	Mesiobuccal

DB	Distobuccal
ABH	Alveolar bone height
MPT	Maxillary posterior teeth
DBG	Deep bite group
NBG	Normal bite group
OBG	Open bite group
MT	Mucosal thickening

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ABSTRACT

Background

In the present research Cone Beam Volumetric Imaging (CBVI) is used for investigation for assessment of vertical relationship between maxillary sinus floor and palatal root tip of maxillary first molar teeth. CBVI is now considered the gold standard for imaging the oral and maxillofacial area due to its numerous advantages.

Aim

To assess the vertical distance between maxillary sinus floor and palatal root tip of maxillary first molar teeth both in coronal and sagittal section using Cone Beam Volumetric imaging. (CBVI): A retrospective study

Objective

To assess the correlation between the maxillary sinus floor and the palatal root tip of the first molar in the coronal and sagittal planes of computed tomographic volumetric imaging (CBVI), and to correlate the obtained data with the patient's age and gender and right and left side of the maxilla.

Result

The Pearson correlation value for age and vertical distance (VD) between maxillary sinus floor and palatal root tip maxillary first molar tooth is 0.226 and 0.224 in sagittal and coronal section respectively which shows a positive correlation. The Pearson correlation for gender and VD is 0.049 in sagittal section and 0.089 in coronal section and for right or left side in sagittal section is 0.100 and in coronal section is 0.090).

Conclusion

The current study suggests that as the age increases, Vertical Distance (VD) between the maxillary sinus floor and the palatal root tip of the maxillary first molar also increases. The gender and the sides of the maxilla does not influence the vertical distance.

1. INTRODUCTION

Maxillary sinus (MS), or antrum of Highmore, is one of the four pairs of paranasal sinuses inside the human skull. The maxillary sinus, for example, is located within the maxillary bones. These air-filled cavities got their names from the bones in which they are found. For head and neck, dental and maxillofacial radiologists, otolaryngologists, rhinologists, oral and maxillofacial surgeons, and others, knowing the anatomy of maxillary sinus is crucial for diagnosis as well for management purposes. (1)

The first paranasal sinus to arise is the maxillary sinus. Leonardo da Vinci originally depicted and described the maxillary sinuses in 1489. Later, in 1651, English anatomist Nathaniel Highmore documented them. The biggest and oldest of paranasal sinuses to form, the maxillary sinus, also known as the antrum of Highmore, is located inside the body of the maxillary bone. The alveolar process of the maxilla, which also supports the teeth, forms the inferior boundary of the sinus. The majority of the maxillary sinus's growth occurs after delivery, despite evidence that it might start to form as early as the 17th week of pregnancy. (1)

In newborn children the viscerocranium is relatively undeveloped. It grows simultaneously with other bones and reaches 25% of its final size by the end of 2 years and up to the 50% by the end of the 8th year of age. According to reports, the viscerocranium grows fastest in the horizontal direction, most extensively in the vertical direction, and slowest in the antero-posterior

direction. [2]

Previous research indicates that the primitive aerated maxillary sinus has a maximal dimension that runs anteriorly-posteriorly and a volume of 6–8 cm^3 at birth. It is hypothesized that the maxillary sinus may be essential in the construction of facial contours, and that its size and shape reflect the evolution of bony structures, which may be related to establishing the shape of the middle face. [2]

All tooth groups have different dental structure, and understanding these differences is essential to effective endodontic therapy since it allows locating and treating each of these root canals appropriately might stop failures in the future.

One of the dental arch's most complicated teeth is the maxillary first molar. The maxillary permanent first molar tooth, has been described as 'possibly the most treated, least understood, posterior tooth'(Bums 1987). [3] In assessing the root canal anatomy of these teeth prior to treatment clinicians must rely on intraoral radiography, and a thorough knowledge of both the commonly occurring configuration of the root canal system and the variations that may occur (Weine et al. 1969, Slowey 1974). The first molar contains three separate roots and three or four canals. [4] Maxillary first molars have three roots in 95.9% of instances, three root canals in 56.8% of cases, and four root canals in 43.1% of cases, according to a study of the literature. Due to the mesial and distal surface's concavities and the large buccolingual dimension of the mesiobuccal root, the presence of the fourth canal is typically documented in

95.6% of instances. In 98.3% and 99% of instances, respectively, there are fewer variations in distobuccal and palatal roots with one canal; these roots frequently fail because a fourth extra canal is present and the dentist is unable to identify, treat, and obturate it. According to Hess et al. (1925), 4 canals are present in 54% of maxillary molars. In contrast, Wein et al. (1969) found that 62% of maxillary molars had a fourth canal. In their 1972 study, Pineda and Kuttler found that 51.5% of maxillary first and second molars had extra canals. (4)

Two-dimensional images of three-dimensional structures are a limitation of two-dimensional imaging techniques. Panoramic radiography was reliable when the root was not in contact with the sinus floor. The finding of root protrusion into the sinus on panoramic radiographs demonstrated a moderate ability to predict root protrusion into the maxillary sinus. Interruption of the maxillary sinus floor could be considered as an indicator of actual root protrusion into the maxillary sinus. Contrarily, CBCT is a very accurate imaging technique for assessing the apex-tooth connection; this is particularly true when radiographs show a root with a protrusion length in the maxillary sinus. Nevertheless, it is not the preferred way for evaluating individual teeth.

The second part of the 1990s saw the beginning of the development of specialist CBCT scanners for use in dentistry. At the moment, CBCT is a commonly utilized technique for several applications in dentistry, including orthodontics, endodontics, maxillofacial surgery, and implant planning. Cone beam computed tomography (CBCT), which enables dentists to examine the interaction between teeth and surrounding tissues, has emerged as a crucial

technique in contemporary dentistry. [5]

CBCT unit results in lesser radiation exposure than that of medical Multichannel CT. Reducing the size of the irradiated area by collimation of the Primary X-Ray beam to the area of interest minimizes the radiation dose Most CBCT units can be adjusted to scan small regions for specific diagnostic tasks. Radiation of a single CBCT scan is about 537 micro sieverts (mean value) (Roberts, Drage & Dauies, 2009). [6]

Comprehending the anatomical relationship between the maxillary sinus and the molar teeth aids in the proper planning of preoperative care and helps prevent complications during minor oral surgical procedures such as extractions or surgical removals involving the maxillary posterior teeth, which are situated in close proximity to the maxillary sinus. The present study will help us to know the projection and protrusion lengths of the teeth root superior to the maxillary sinus floor as well as the changes in their vertical distance based on the gender of the individual which will be beneficial for better prognosis and treatment plan.

2. AIMS AND OBJECTIVES

Aim

Assessment of the relationship of palatal root tip of maxillary first molar with maxillary sinus floor in both coronal and sagittal section using computed tomography volumetric imaging (CBVI): A retrospective study.

Objective

- To evaluate relationship between palatal root tip of maxillary first molar with the maxillary sinus floor in both coronal and sagittal plane of computed tomography volumetric imaging (CBVI)

- To evaluate the vertical distance between the palatal root tip of maxillary first molar and floor of maxillary sinus in coronal and sagittal plane of computed tomography volumetric imaging. (CBVI)

- To correlate the data with age and gender of the patients.

- To correlate the vertical distance between and palatal root tip of maxillary first molar and maxillary sinus floor in both right and left maxilla.

3. REVIEW OF LITERATURE

3. A) Anatomy of maxillary sinus

The first paranasal sinus to arise is the maxillary sinus. Leonardo da Vinci originally depicted and described the maxillary sinuses in 1489. Later, in 1651, English anatomist Nathaniel Highmore documented them. The biggest and first of the paranasal sinuses to form, the maxillary sinus, also known as the antrum of Highmore, is located inside the body of the maxillary bone.

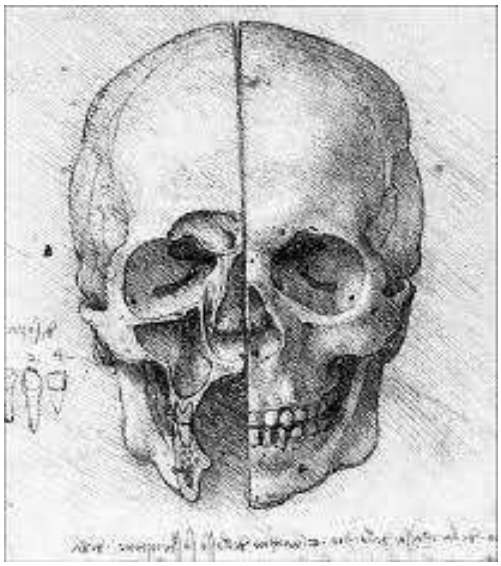

Figure 1: Diagrammatic illustration of maxillary sinus.

The maxilla's anterior wall constitutes its face. The orbital floor is located superiorly. The ethmoid infundibulum receives the maxillary sinus's medial drainage through the natural ostium. The ostium is situated lateral to the uncinate process, usually at the level of the middle turbinate's lower part. The ostium is situated just above the inferior turbinate or in the superior portion of

the medial maxillary sinus wall. The real ostium has a teardrop or elliptical form. Ten to twenty percent of individuals have an auxiliary or fake ostium in the posterior fontanelle; they are often rounder in shape. Mucus recirculation may happen if the accessory ostium is not linked to the actual ostium. The distance between the nasolacrimal duct and the maxillary sinus ostium is between 0.5 and 1.8 mm. The ostium is never anterior to the anterior free border of the middle turbinate, which is a crucial relationship to keep in mind.

Earlier studies reveal that the height of the Maxillary sinus increases continuously up to the age of 18 years. By the age of 12, however, the breadth and length (anteroposterior dimension) of the MS approach adult proportions. The MS grows at the fastest rate between 0 and 4 years, then more gradually between 4 and 8 years. A gender difference in MS size develops after the age of 8 years with a plateau in females and a slow increase in size in males up to the age of 18 years. The development of the MS continues until the third decade in males and the second decade in females that follows loss of a posterior maxillary tooth, especially the first molar. Most studies have shown that in both gender no changes in sinus volume with dentition status (presence or absence of premolars or molars) and a decrease in volume with advancing age is observed. Measurements of the adult MS vary significantly between different studies; the range of dimensions is 38–45 mm in length, 25–35 mm in width and 36–45 mm in height. The average MS volume from multiple studies is 150 mm^3 with a range of 100–250 mm^3. [(1)]

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Consequently, protecting the nasolacrimal duct during an uncinectomy and maxillary antrostomy may be accomplished by maintaining visibility of the middle turbinate. Postoperative epiphora may arise from injury to the nasolacrimal duct. A branch of the sphenopalatine artery (SPA) may induce bleeding; hence caution must be used while extending the maxillary antrostomy posteriorly. The sphenopalatine artery leaves the infratemporal fossa, which is situated farther lateral than the pterygopalatine fossa, which is situated posterior to the maxillary sinus. The crista ethmoidal is, the middle turbinate’s attachment place, is directly posterior to the sphenopalatine foramen, which lies where the sphenopalatine artery exits. Usually, there are many submucosal branches that serve as the feeders for the lateral nasal wall. The maxillary sinus is where the infraorbital nerve indentates and, in certain situations, hangs into the maxillary sinus as it passes over the inferior orbital floor. Haller cells are ethmoid cells with an origin that pneumatize into the maxillary sinus. Another name for them is infraorbital ethmoid cells. These cells should be identified before

surgery because they provide a danger of inadequately establishing a drainage channel. Regarding the sphenoid ostium, which is situated at the same level as the maxillary sinus and will be discussed subsequently, the associated maxillary ostium offers an excellent, consistent, and reliable marker. [3]

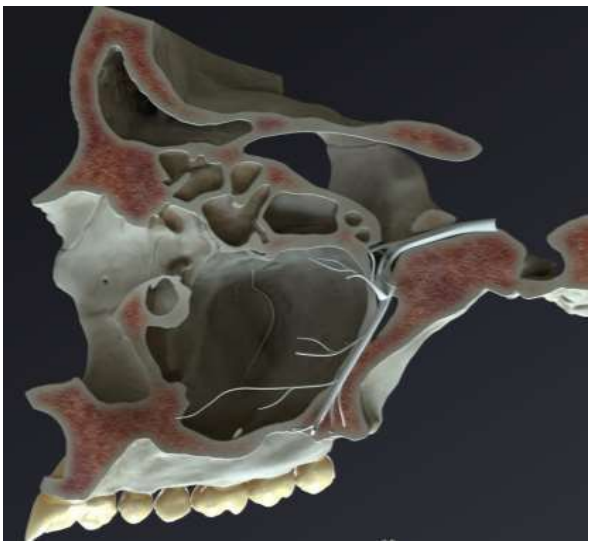

Figure 2: Anatomy of maxillary sinus

During the initial years of life, it is typical to have partial or total opacification of the maxillary sinus. The development of the face bones and the maxillary sinus are correlated. Both happen in phases. The first phase lasts for the first three years of life, at the conclusion of which the sinus extends lateral to the infraorbital canal. The second stage of growth takes place in years 6 through 12, with inferior extension reaching the level of the hard palate by age 9 and lateral extension reaching the maxilla's zygomatic recess. Pneumatization of the maxillary alveolus during the third phase causes the sinus to expand further, pushing the sinus floor 4-5 mm below the nasal cavity's floor when the permanent molar and premolar teeth emerge. [1] Previous research indicates that the primitive aerated maxillary sinus has a maximal dimension that runs

anteriorly-posteriorly and a volume of 6–8 cm^3 at birth. It is hypothesized that the maxillary sinus may be essential in the construction of facial contours, and that its size and shape reflect the evolution of bony structures, which may be related to establishing the shape of the middle face. [(2)] The maxilla's anterior wall constitutes its face. The orbital floor is located superiorly. The ethmoid infundibulum receives the maxillary sinus's medial drainage through the natural ostium. The ostium is situated lateral to the uncinate process, usually at the level of the middle turbinate's lower part. The ostium is situated just above the inferior turbinate or in the superior portion of the medial maxillary sinus wall. The real ostium has a teardrop or elliptical form. Ten to twenty percent of individuals have an auxiliary or fake ostium in the posterior fontanelle; they are often rounder in shape. Mucus recirculation may happen if the accessory ostium is not linked to the actual ostium. The distance between the nasolacrimal duct and the maxillary sinus ostium is between 0.5 and 1.8 mm. The ostium is never anterior to the anterior free border of the middle turbinate, which is a crucial relationship to keep in mind.

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sphenopalatine artery exits. Usually, there are many submucosal branches that serve as the feeders for the lateral nasal wall. The maxillary sinus is where the infraorbital nerve indentates and, in certain situations, hangs into the maxillary sinus as it passes over the inferior orbital floor. Haller cells are ethmoid cells with an origin that pneumatize into the maxillary sinus. Another name for them is infraorbital ethmoid cells. These cells should be identified before surgery because they provide a danger of inadequately establishing a drainage channel. Regarding the sphenoid ostium, which is situated at the same level as the maxillary sinus and will be discussed subsequently, the associated maxillary ostium offers an excellent, consistent, and reliable marker. [3]

- **Cullen RL et. al.** [7] **(1972)** conducted research to investigate the dimension and shape of the human maxillary sinus in the perinatal period. The study included 17 specimens in the perinatal period consisting of 11 males (2.8-month-old, 4 stillborn,1 at term, 1, 2 days old).and 6 female fetuses (1 of 7 months, 2 stillborn, and 1 at term). Specimens with any record of maldevelopment on the official certificate were not considered. The maxillary sinus was exposed by removing nasal septum and middle concha and was approached through medial wall. This study reveals five different shapes of maxillary sinus: elliptical (13 cases), triangular (9 cases), irregular (6 case), rectangular (4 cases), spherical (1 case). The mean value of anteroposterior, superior-inferior, and medio- lateral dimensions of the maxillary sinuses are, respectively 10.6 mm, 4.8 mm, and 3.3 mm. The study showed no sexual dimorphism in the size of the sinus within the same age group.

- **Farah G et. al. [8] (2006)** conducted research to measure bilateral changes in the maxillary sinuses, their various sizes, their development trend, and their sexual dimorphism. Thirty-seven human fetuses from the department of obstetrics and gynecology, representing all age groups and free of congenital craniovertebral abnormalities, were chosen for the research and immersed in 10% formalin. Based on age, fetuses were separated into five groups. Using fetal foot length as a criterion, fetuses under seventeen weeks of age were categorized as I, those between seventeen and twenty weeks as II, twenty-one to twenty-five weeks as III, and twenty-six to thirty as group IV and the remaining fetuses, or those above thirty weeks, as group V. Throughout the intrauterine life, the maxillary sinus's anteroposterior diameter grew steadily, reaching a maximum of (+71%), during weeks 26–30 and a notable (+48) percent during weeks 17–20. In the latter case, the P value was very significant (< 0.001). During the later stages of intrauterine life (>30 weeks), there was only a little development (+10%) in the anteroposterior diameter. Although this parameter continued to expand throughout the fetal life, the rate of growth decreased in later stages and was negligible during the first 26–30 weeks of intrauterine life. Then the growth was almost stand still till birth. Anteroposterior dimensions showed faster growth while other diameters were in pace with the head circumference. It was concluded that: 1) Different diameters of maxillary sinus have spurt of growth in different periods of intrauterine life. 2) Values of anteroposterior diameter remain higher, right from the beginning to the end of intra-uterine life. 3) Maxillary sinuses remain relatively larger in males throughout life.

- **Jasim HH et. al. [9] (2013)** conducted a study to determine the size and volume of the maxillary sinus in people with dentate and edentulous maxillae. Additionally, establish a correlation between the age and gender of the maxillary sinus and its volume by utilizing a CT scan was established. This study involved 120 patients, aged 40 to 69, who were divided into two groups: the dentate group, which had a fully dentate maxilla, and the edentulous group, which had a complete edentulous maxilla. Thirty male and thirty female patients were included in each made up each group. There were no significant differences in the measurements of maxillary sinuses between the dentate and edentulous groups, with the exception of height measurements, which were significantly higher in the edentulous group for both genders than the dentate group. The statistical analyses of maxillary sinus measurements for the dentate and edentulous groups revealed that the volume and dimensions of maxillary sinuses in both groups were larger in males than females and they tend to decrease with older age.

- **Lozano-Carrascal N et. al. [10] (2017)** conducted research to assess the primary anatomical features of the maxillary sinus by Cone Beam Computed Tomography (CBCT) in order to aid in the avoidance of problems before and after surgery. Analysis was done on three hundred CBCT images from patients having implant surgery. The anatomical structures listed below were assessed: (1) Residual ridge height (RRH) and width (RRW); (2) Ridge bone density (BD); (3) Maxillary sinus angle (MSA); (4) Maxillary sinus lateral wall thickness (LWT); (5) Schneiderian membrane thickness (MT); (6) Maxillary sinus septa (SS); (7) Posterior superior alveolar artery (PSAA). The result showed mean patient age was 59.5±13.6. Mean RRH at upper second premolar

(2PM) was 8.66±3.95 mm, 4.90±2.28 mm at first molar (1M), and 5.26±2.13 mm at second molar (2M). Mean RRW was 6.72±2.69 mm at 2 PM, 6.87±2.65 mm at 1M and 7.09±2.80 mm at 2M. Bone Density was 330.93±211.02 Hounsfield Units (HU) at first molar position and MSA was 73.39±15.23º. LWT was 1.95±0.98 mm. Mean Schneider Membrane thickness (MT) was 1.82±1.59 mm; MT was ≤ 3mm in 72.9% of patients and >3mm in 27.10%. 20.56% of patients presented bucco-palatal oriented septa with a mean height of 13.11±3.82 mm. PSAA was observed in 48.60% and mean distance to the top of the ridge was 13.15±3.71 mm, and was mostly observed inside the sinus (53.85%).

- **Luz J et. al. [(11)] (2018)** conducted research to measure the 3D osseous and soft tissue defined volume and surface area of the maxillary sinus. A total of 128 maxillary sinuses in 64 patients were analyzed using cone-beam computed tomographic data. Surface area and volume of the osseus maxillary sinuses as well as of the remaining pneumatized cavities in cases of obliterated sinuses were calculated. Result reveals that for osseus bordered sinuses, mean surface area was 39.7 cm2 and mean volume 17.1 cm3. For the remaining pneumatized cavities, mean surface area was 36.4 cm2 and mean volume 15 cm3. The calculated mean volume of obliterated sinuses (42.2% of all sinuses were obliterated) was 5.1 cm3. Further, an association between the obliterated volume and the presence of pathologies was detected. Male patients showed a significantly higher mean osseus volume compared to female patients. No association was apparent between a patient's age or dentition state and sinus volume.

- **Demiralp KO et. al. [12] (2019)** conducted research to ascertain whether cone-beam computed tomography (CBCT) scans can be used to establish gender and age estimation for ancient skulls by measuring the paranasal sinus volume and dimensions. For this study, thirty-two ancient dried skulls from the 800–1000 C.E. period were discovered during specific archaeological digs in Anatolia, Turkey. The skulls were thought to be around 1000 years old. One anthropologist who worked independently established the age and gender of each skull. The average age of the 18 ancient male skulls was assessed to be 41.4 ± 10.2 years, while the mean age of the 14 ancient female skulls was determined to be 39.6 ± 9.2 years. It was discovered that the left and right maxillary sinus volumes were 4.72 cc (min: 1.71; max: 10.63) and 5.46 cc (min: 2.23; max: 9.73), respectively. Regarding the maxillary sinus volume and dimensions, there was no discernible difference between the left and right.

- **Aktuna Belgin C. et. al. [13] (2019)** conducted research to analyze how the maxillary sinus volume varies with age and gender. A retrospective assessment of 2,000 images from the radiology archive was conducted. The inclusion criterion of the patients was the one who had undergone CBCT imaging for dental implant surgery, orthognathic surgery, impacted third molar surgery, cyst or tumor of dental structures but had not affected the maxillary sinus. The maxillary sinuses' architecture or integrity were not impacted by any disease (fracture, inflammation, residual root, overflowing endodontic material, or condition needing surgery) in the patients chosen for this investigation. Patients had all permanent teeth aside from the third molars and were above the age of eighteen. Patients in the maxillary and mandibular posterior areas

who did not have any missing teeth were chosen. The study comprised 200 patients' CBCT scans (86 males and 114 females) who fulfilled the study's requirements. Patients were separated into five age groups (aged 18–24 [n = 35], aged 25–34 [n = 65], aged 35–44 [n = 50], aged 45–54 [n = 30], and aged ≥55 [n = 20]) according to their sex. Each patient's right and left maxillary sinus volumes were determined independently, resulting in a total of 400 maxillary sinus volumes being recorded. The bilateral maxillary sinus volume ranged from 11.10 to 51.97 cm^3, with an average of 29.09 ± 7.829 cm^3 (P>0.05) indicated that the mean right and left maxillary sinus volume were 14.49 ± 3.998 cm^3 and 14.59 ± 3.984 cm^3, respectively. The right and left sinus volumes did not differ in a way that was statistically significant. Men's and women's mean maxillary sinus volumes were 31.62 ± 8.430 cm^3 and 27.18 ± 6.778 cm^3, respectively. Males had a substantially higher maxillary sinus volume than females did. Age group differences in maxillary sinus volume were statistically significant (p<0.05). The mean square variation (MSV) declined with age, with patients between the ages of 18 and 24 having a substantially higher maxillary sinus volume than those patients beyond the age of 35.

- **Amine K. et. al. [(14)] (2019)** conducted research to evaluate maxillary sinus anatomical variations and lesions. It was a retrospective analysis using cone beam computed tomography. A total of 300 CBCT scans were included in the research, of these, 117 (39 %) patients were men and 183 (61 %) were women. The findings consisted in: ventilation 91%, septa 34.66%, total compartmentalized sinus 6%, hypoplastic sinus 5%, aplastic sinus 0%, prolapsed sinus 1.66%, endorsed position of the antral artery 53%, submucosa

position 43%, thickening of the sinus mucosa 41%, sinus opacity 4%, polyps and the cysts 20.33%. The average thickness of the anterolateral wall was about 1.16 ± 0.48mm. This study concluded that maxillary sinus has great interindividual anatomical variability.

- **Gulec M. et. al. [(15)] (2019)** using cone-beam computed tomography (CBCT) images in a Turkish subpopulation, a study was conducted a study to ascertain the volumetric size of the maxillary sinus and examine the impact of gender and age on maxillary sinus volume (MSV). The study recommended that a CBCT should be strongly considered to accurately assess oral surgery risk with regard to maxillary posterior teeth. The 133 participants in this retrospective volumetric CBCT research ranged in age from 8 to 51, with 84 females and 49 males. Each person's right and left maxillary sinus volume were computed independently (the same observer recorded 266 maxillary sinus volume in total). This study revealed no notable correlation between age/gender and right/left maxillary sinus volumes in a Turkish subpopulation.

- **Maspero C et. al. [(16)] (2020)** conducted research to evaluate changes of maxillary sinuses in growing subjects. 146 patients' Cone Beam Computed Tomography (CBCT) scans were categorized by age and gender (6–8, 9–11, 12–14 years old). Calculations were made for the left, right, and total maxillary sinus volume (MSV-R, MSV-L, MSV-Tot), as well as the left and right linear maximum width (LMW-L, LMW-R), depth (LMD-R, LMD-L), and height (LMH-R, LMH-R). The dimensions of the right and left maxillary sinuses in age groups 1, 2, and 3 showed no significant difference in either of

the gender. Male participants' maxillary sinuses increased statistically significantly mostly between groups 2 and 3, which is equivalent to the growth peak of male pubertal development. The sinuses in the maxilla of female participants had a less steep increase in development from the outset. It was shown that there was a statistically significant rise between groups 1 and 2 as well as between groups 2 and 3. As a result, the female subjects' sinuses developed earlier than the male subjects' at the time of their peak growth. In both sexes, the maxillary sinus development appears to coincide with the growth peak. In females, this development starts between the ages of 9 and 11, while in males it starts between the ages of 12 and 14.

- **Teixeira LC et. al. [17] (2020)** carried out studies to assess if utilizing the CBCT images of the maxillary sinus (MS), age and sex can be determined in a Brazilian population. The linear measures (height, breadth, length, inter-sinuses distance, and maximum distance between sinuses) and volume calculation of both MS were carried out after the CBCT scans of 420 people (228 females and 192 males) were retrospectively selected. Two age categories (18–40 years old and > 40 years old) were used to divide the sample. To confirm that the metric parameters accurately expressed sexual dimorphism and age prediction, the data were subjected to discriminant functional analysis and descriptive functional analysis (independent Student t test). Males had greater measures of all MS parameters. However, there were no differences between the left and right sides ($p>0.05$). The most effective individual sex discriminator was the height of the right MS (66.9%). The total sex determination accuracy percentage when all criteria were taken into account

was 73.6%. When it came to age, the youngest group had greater bilateral MS volume, left MS length, and both sinus' heights ($p < 0.05$). The results were lower ($p < 0.001$) for the younger group only for the inter-sinuses distance. The age determination accuracy percentage was 67.6%.

- **Alshiddi HA et. al. [18] (2022)** carried out research to evaluate the accuracy of digital and manual mathematical approaches for estimating the maxillary sinus volume from CBCT scans and to ascertain if the patient's age, gender, or edentulous status affects the maxillary sinus volume. In order to determine the maxillary sinus volume (MSV), the supero-inferior and bucco-palatal dimensions of 639 residual ridges, and the inferior cortical thickness of the maxillary sinus, a retrospective CBCT research including 247 participants (336 maxillary sinuses) was carried out. Regarding the patient's age, gender, and edentulous status, there were no appreciable variations in the maxillary sinus volume. It was discovered that the digital measurement of MSV was more accurate and practical than the geometric measures. With a mean height of 7.07 mm, the left maxillary second molar site was the most resorbed region.

3. B). Anatomy of maxillary first molar teeth

The maxillary permanent first molar tooth, has been described as 'possibly the most treated, least understood, posterior tooth'(Bums 1987). In assessing the root canal anatomy of these teeth prior to treatment clinicians must rely on intraoral radiography, and a thorough knowledge of both the commonly occurring configuration of the root canal system and the variations that may occur (Weine et al. 1969, Slowey 1974).

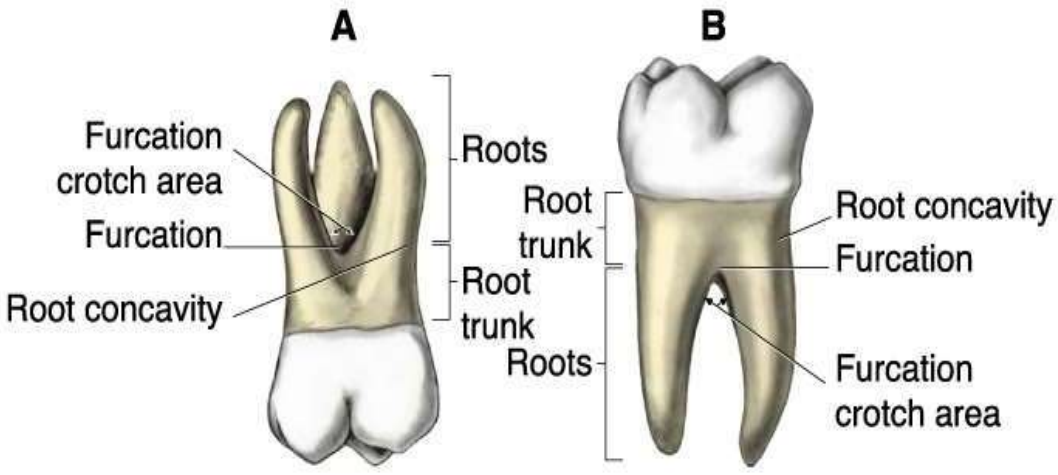


Figure 3: Pictorial representation of maxillary 1st molar teeth

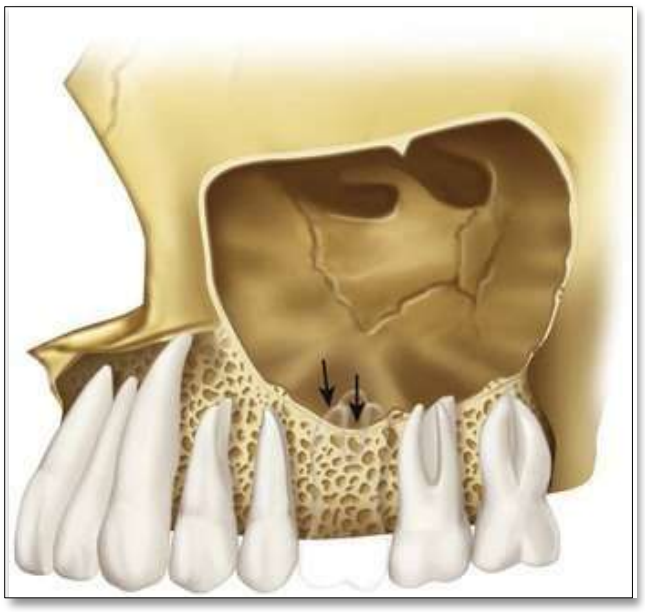


Figure 4: maxillary sinus and maxillary first molar teeth

The first molar contains three separate roots and three or four canals. [(4)] Maxillary first molars have three roots in 95.9% of instances, three root canals in 56.8% of cases, and four root canals in 43.1% of cases, according to a study of the literature. Due to the mesial and distal surface's concavities and the large buccolingual dimension of the mesiobuccal root, the presence of the fourth canal is typically documented in 95.6% of instances. In 98.3% and 99% of instances, respectively, there are fewer variations in distobuccal and palatal roots with one canal; these roots frequently fail because a fourth extra canal is present and the dentist is unable to identify, treat, and obturate it

- **Zhang R et. al. [(19)] (2011)** conducted a study by using cone-beam computed tomography (CBCT) to examine differences in root canal shape in the

maxillary permanent molar teeth of a Chinese subpopulation. A total of 269 individuals, including those with facial injuries and those in need of a pre-operative evaluation for implants, were included with healthy, untreated, well-developed maxillary molars. A standard examination, diagnosis, and treatment planning process included a radiographic evaluation performed by CBCT. CBCT was used to evaluate 299 maxillary first molar teeth and 210 maxillary second molar teeth in vivo. Records were kept on the quantity of roots, the number of canals in each root, the arrangement of the canals, and the existence of extra mesiobuccal canals. For root-canal configurations, Vertucci's categorization was applied. Mesiobuccal roots of maxillary molar teeth had more variation in their canal system than the distobuccal or palatal roots. The root canal configuration of the maxillary second molars was more variable than that of the first molars. CBCT can enhance detection and mapping of the mesiobuccal root-canal system with the potential to improve the quality of root canal treatment.

- **Rouhani A et. al. [(20)] (2014)** carried out research to identify the root and canal morphology of maxillary first and second molars in Iranian population by taking and analyzing cone-beam computed tomography (CBCT) scans. A total of 250 extracted maxillary molars 125 first and 125 second molars were gathered from five Iranian metropolises, located in the country's five different regions: Tehran in the north, Mashhad in the east, Tabriz in the west, Bandar Abbas in the south, and Isfahan in the middle. A continuous evaluation of axial, coronal, and sagittal CBCT images was conducted by moving the toolbar from the pulp chamber floor to the apex. The following questions were

looked at by two endodontists who examined the CBCT scans: quantity of roots and quantity of root canals in every root. The study followed the Vertucci's classification of root canals. This study reveals four roots were seen in two (1.6%) maxillary first and two (1.6%) maxillary second molars. In maxillary first and second molars, the prevalence of root fusion was 2.4% and 8.8%, respectively. Type I canal morphology predominated in the mesiobuccal roots of three-rooted first and second molars (46.4% and 80.8%, respectively), with type VI canal morphology coming in second (17.6%) molars. In first and second molars, type I distobuccal and palatal root morphology predominated. There was also other type of canals found.

- **Naseri M. et. al. [(21)] (2016)** conducted a study using cone-beam computed tomography (CBCT) to examine the root and canal morphology of maxillary first molars in relation to the age and gender of the individuals. A total of 149 CBCT scans with a mean age of 40.5 years were analyzed, representing 92 (67.1%) female and 57 (31.3%) male patients. The following factors were noted: tooth length, root fusion presence, number of roots and canals, canal types according to Vertucci's categorization, deviation of root and apical foramen in coronal and sagittal planes, and association between all items and age and gender. For female and male patients, the mean tooth length was 19.3 and 20.3 mm, respectively. While the difference did not significantly change with age, there was a statistically significant difference (P=0.001). Both male and female patients had the same three roots at 100% of the time. Three roots were independent in the majority of instances (98.7%), although a small percentage (1.3%) exhibited fusion of the roots, which was unrelated to gender or age. With the

exception of the mesiobuccal root in the sagittal plane, where the frequency of straight roots and distal deviations were larger in men and women, respectively, the deviations of the roots did not significantly change with gender or age. Type I canal configuration predominated in 89.9% of distobuccal and 96.6% of palatal roots, despite the presence of type V canal configuration in both distobuccal and palatal roots. In patients who were both female (34.8%) and male (36.6%), the most prevalent canal configuration in the mesiobuccal root was type VI, which was followed by type II, I, IV, and V. There were no Type VII or VIII observations. The canal configuration of maxillary first molars did not statistically differ with gender and age.

- **Gulati S. et. al.** [22] **(2023)** conducted research to measure the distance between the radiographic apex and the apical exit of the palatal root of the maxillary first molar, measuring the angulation of the apical exit from the maxillary sinus floor, and measuring the apical exit of the palatal root of the maxillary first molar. The study comprised CBCT pictures of a permanent maxillary first molar with a well-developed palatal root and a single root canal in individuals between the ages of 18 and 40. CBCT scans with root canal therapy for the maxillary first molar, broken palatal roots, fused roots, C-shaped canals, root resorption, periapical lesions, or disease related to the maxillary sinus were excluded. In certain instances, the apical exit does not align with the radiographic apex. The radiographic apex is located between 0

and 1.43 mm from the apical foramina or apical exit. In 75% of instances, the maxillary sinus floor is directly in touch with the apical exit or apical foramina.

3. C). Panoramic radiographic evaluation of vertical distance between maxillary molar teeth and maxillary sinus floor

- **Arabion H et.al. [23] (2015)** conducted study to compare the relationships and distance between maxillary root tips and the maxillary sinus floor using panoramic radiograph in the dolichocephalic and brachycephalic compared to mesocephalic individuals. 149 men and 151 women made up the research population, which was divided into three study groups: dolichocephalic, mesocephalic, and brachycephalic; consisting of 99, 98, and 103 instances in total. The cephalic index (CI), which is determined by multiplying the ratio of the head's width above the ears by the head's length from the forehead to the most prominent point of the occiput, was used to classify the patients into the mesocephalic, dolichocephalic, and brachycephalic groups. CI scores between 75 and 80 are classified as typical population or mesocephalic. Dilococephalic groups are defined by values less than 75, and brachycephalic groups are defined by values more than 80. Clinical measurements were taken using the patients' actual body sizes. Panoramic images were evaluated for vertical relationship of root tips of the maxillary first and second molar teeth and the maxillary sinus floor. Each root tip was categorized into a single group for the purpose of describing four different types of relationships for the qualitative evaluation of the maxillary root tip and inferior wall of the sinus. Cases classified as Type 1 had roots that were situated far from the cortical boundaries of the Sinus. Type 3 showed the root's shadow covering the maxillary sinus without actually penetrating the cavity, whereas Type 2

showed the tight contact between the maxillary root tip and maxillary sinus floor. Type 4 relationships were identified for root tips that protruded into the sinus cavity. The results reveal the distance was significantly higher in the brachycephalic groups than that of the mesocephalic, and the mesocephalic group showed longer distance in comparison to dolichocephalic individuals. Qualitative comparison showed that type 1 relationship was the dominant position in the brachycephalic individuals while most of dolichocephalic individuals demonstrated type 2 and 3 relationships of the molar root tips and the maxillary sinus floor.

- **Pertiwi AD et. al. [(24)] (2016)** conducted research to analyze digital panoramic radiograph about positions of the root of maxillary posterior teeth with maxillary sinus floor by age and gender using. The digitized panoramic radiograph records of the patients were used to create the study population. 207 digitized panoramic radiograph archives yielded 88 samples. The tooth root will be categorized as type 1 position if the lamina dura and periodontal membrane are not apparent on the superimposed description of the tooth root with maxillary sinus, and if the root apical entered into the maxillary sinus floor. Type 2 positions are those in which the apical root makes contact with the floor of the maxillary sinus. The periodontal membrane and lamina dura appear as intake at the superimposition description of root teeth with the maxillary sinus if the apical root is below the floor of the sinus, then it will be categorized as type 3. The findings indicated that 1st premolar (86.8% right, 88.2% left) dominated type 3, 2nd premolar (24.7% right, 21% left) dominated

type 2, and 2nd molar (31.2%) and 1st molar (38.1%) dominated type 1. Type 3 was the most often discovered variation.

- **Dehghani M. et. al. [25] (2017)** performed research to understand the anatomical and pathological relationships between posterior teeth or edentulous area with maxillary sinus is essential for diagnosis and treatment management. The present study aimed to assess the relationship between maxillary sinus floor and posterior teeth roots using panoramic radiography and Cone Beam Computed Tomography (CBCT). 55 individuals' first and second molars as well as 440 maxillary first and second premolars were chosen for this analytical cross-sectional investigation. This study reveals to take CBCT images for better assessment and minimizing damage, oroantral communication, and infection

- **Tripathi K et. al. [26] (2021)** carried out research employing a digital orthopantomogram to compare the relationship and measurements between the floor of the maxillary sinus and the root points of the maxillary posterior teeth in various cephalic index patients. Based on their cephalic index, 210 patients were classified as brachycephalic, mesocephalic, or dolichocephalic. The age range was within 20-55 years of age. After undergoing orthopantomograms to assess the vertical connections between the maxillary posterior teeth and the maxillary sinus floor, the individuals' interproximal distances were assessed. A statistical analysis was performed on the gathered data. Four categories were used to categorize each root tip: In accordance with Arabion H et al.'s categorization, types 1, 2, 3, and 4. Type 1: A root that is far from the sinus

floor; Type 2: A close touch between the tip of the root and the sinus floor; Type 3: A root that protrudes into the sinus cavity without really penetrating; Type 4: A root that protrudes into the sinus cavity. To differentiate between Type 3 and Type 4, the lamina dura's uninterrupted continuity was utilized. The deepest point was then connected by perpendicular lines. posterior teeth (1st and 2nd premolars and 1st and 2nd molars) in orthopantomograms and the distances were measured and recorded in all the three groups. Results showed no significant differences in the relation between the maxillary sinus floor and root tips for both premolars and molars in male and female subjects.

3. D). Computed Tomographic evaluation of vertical distance between maxillary molar teeth to maxillary sinus floor

- **Lupoi D et. al.** [27] **(2021)** conducted a study to precisely measure the distance between maxillary sinus floor and roots of posterior teeth and to see which tooth is most frequently located in close proximity to the maxillary sinus. In the study group, 65 CT images were included. They matched 37 males (56.92%) and 28 women (43.08%), in that order. With a mean age of 74 years, the oldest patient was 22 years old. Forty-five was the median age. The results revealed the first molars (95.15% on the right side and 96.23% on the left) and second molars (96.08% on the right side and 90% on the left) had the closest distances. For the second and third PM, the sinusal approach's percentage ranged from 82% to 86%.

3.E) <u>Cone Beam Computed Tomographic evaluation of relationship between maxillary molar teeth and maxillary sinus floor</u>

Sir Godfrey N. Hounsfield introduced CBCT in 1967. It was initially developed in 1982 for angiography and then used for maxillofacial imaging. It has only been feasible to create clinical systems that are affordable and compact enough to be utilized in dentistry offices since the late 1990s. [(6)]

Figure 5: Cone Beam computed Tomographic machine

The X-ray source and collector that comprise the cone beam computed tomography (CBCT) apparatus function similarly to a traditional computed tomography (CT) scanner. When electrons from the cathode impact the anode at the X-ray source, the majority of the energy is transferred to heat and the

remaining energy is converted, via the Bremsstrahlung effect, into X-rays. In the meantime, X-rays are sent over the patient's head to collectors, which convert the photons into electrical impulses. The X-ray tube and collector may rotate around the mandibular area to acquire many head slices and associated two-dimensional data. After that, this data is processed to create 3D models. [5]

Radiation dosage needs to be adjusted in accordance with the ALARA (as low as reasonably achievable) concept, to ensure that the radiation received by tissues of clinical interest is not more than what is necessary for sufficient imaging. Only in cases where there are more therapeutic advantages than dangers from ionizing radiation exposure should CBCT be used. Before children and teenagers are exposed, additional considerations should be taken into account. Standard oral imaging modalities should be used in conjunction with CBCT. Consideration for CBCT should only be given if the standard oral radiography is unable to identify the oral anatomy or other specific information that is required. [6]

A highly advantageous aspect of CBCT imaging from a therapeutic standpoint is its sophisticated software, which facilitates the analysis, interpretation, and reconstruction of the vast amounts of data collected. This significantly enhances the ease of use when interpreting data, given that the required level of knowledge and technical proficiency is fulfilled.

- **Thomas RP et. al. [28] (1993)** conducted research to investigate details on the structure of the pulp chamber and root canals of maxillary permanent first molar teeth, particularly highlighting anatomical variations that could exist at

various ages. The root canal anatomy and pulp chamber morphology of 216 maxillary permanent first molar teeth of known age was examined using a radiographic technique after infusion of the root canal system with a radiopaque sodium iothalamate gel. He investigated that out of the 216 teeth, 204 had three roots and 12 had only two roots. The teeth with only two roots Included nine in which the disto-buccal and the palatal roots were Joined and three in which the disto-buccal and the mesio buccal roots were Joined. While some root apices appeared completely formed at age 9, in the majority of teeth the root apices still exhibited a blunderbuss appearance at 10 years, and did not exhibit a mature form until age 12 or later. Generally, the palatal root apex matured slightly later than the disto-buccal and mesio-buccal apices, with some palatal canals still exhibiting an incompletely formed apex at age 15.

- **Kwak HH et. al. [29] (2003)** carried study to explain the anatomy and clinical features of the maxillary sinus, especially the inferior wall in Koreans, and to determine the connection between the roots of the maxillary teeth and the inferior wall of the sinus. In this investigation, twenty-four sides of hemi-sectioned Korean skulls' maxillae were employed. After decalcification, each specimen was sectioned coronally. Twenty-one items were measured with an image analysis system on the sectioned specimens. Measurements were made of the separations between each root apex and the maxillary sinus's inferior wall. In the first premolar region, the distance was greatest, and in the second molar area, it was the smallest from the root apex to the inferior sinus wall. The first premolar area of the maxillary sinus had the smallest cortical plate thickness, whereas the second premolar area had the

thickest. Five categories were used to categorize the vertical connection between the maxillary molar roots and the inferior wall. Type I, the inferior wall of the sinus located above the level linking the buccal and lingual root apices, predominated at 54.5% in the first molar region and 52.4% in the second molar area.

- **Kim KA et. al. [30] (2008)** conducted research to evaluate the positional connection utilizing a cone beam computed tomography (CBCT) between the maxillary sinus floor and the apex of the maxillary first molar. Analysis was done on 127 participants' CBCTs. The vertical and horizontal positional relationships of 134 maxillary first molars to the maxillary sinus floor were used to classify them, and the distance between the maxillary sinus floor and the maxillary first molar was measured. On the vertical relationship between the maxillary sinus floor and the apex of the maxillary first molar, type III (the root projected laterally on the sinus cavity but its apex is outside the sinus boundaries) was dominated between 10 and 19 years, and type I (the root apex was not in contact with the cortical borders of the sinus) was dominated ($P<0.05$) between 20 and 72

  years. For the palatal root, the maxillary sinus floor was found more near the apex (78.2%) than at the furcation (21.3%). Age differences ($P<0.05$) were seen in the length of time between the root apex and the maxillary sinus floor restricted to type I.

- **Didlescu A. et al. [31] (2012)** conducted a study by using the dental CBCT images. The dental CBCT images and the demographic data of 97 patients were obtained from the archives belonging to the Clinic of Oral

Implantology, "Dr. Carol Davila" Central University Emergency Military

- Hospital, Bucharest, Romania. The images were examined and Lines were drawn on the cross-sectional images between the deepest point of the maxillary sinus floor and the root tips of the maxillary first molar, and the distances were measured using built-in measurement tools and Images were grouped according to the size of measurements performed between the root tips and the maxillary sinus. The study shows the distance is ranging between 0-7.63 mm in case of palatal root, 0-9.71 mm in mesio- buccal and 0-7.59 mm disto-buccal root and the average distance from furcation is 2.25 to 14.9 mm. This study also shows no significant influence of gender in the mean value of measurements.

- **Pagin O et. al.** [32] **(2013)** conducted a study with the aim to evaluate the close proximity established between the maxillary sinus floor and posterior teeth roots apices by using cone-beam computed tomographic scanning. This study demonstrated that the sinus floor and the apex of the second molar mesiobuccal root are typically in close contact. When treatment planning, CBCT technology was helpful in demonstrating the clinical relationship between the MSF and the posterior tooth root apices. Additionally, in order to reduce the danger of an infectious condition within the sinus and avoid an iatrogenic operation, the closeness of these anatomic structures should be taken into consideration.

- **Shokri A et. al.** [33] **(2014)** conducted a study to assess the vertical and horizontal relationship between the maxillary sinus floor and maxillary

posterior teeth roots using cone beam computed tomography. In this cross-sectional study 214 first premolars, 217-second premolars, 220 first molars and 220-second molars were included. The majority of the teeth in this research did not come into contact with the sinus floor, however the more posterior the maxillary teeth, the greater the likelihood that a root may protrude into the maxillary sinus. It also shows that males are more likely than females to have tooth roots protruded into the maxillary sinus.

- **Ok E et. al. [34] (2014)** conducted a study to evaluate the relationship between each root of maxillary premolars and molars and the maxillary sinus floor according to sex, sinus position, and age by decade in a Turkish population by using cone beam computed tomography (CBCT) scanning. In this research a database including 5,166 CBCT images from 849 individuals (2,680 maxillary premolars and 2,486 maxillary molars). Three types of relationships were identified between the molar and premolar teeth's roots and the sinus floor: type 1 involved roots that pierced the sinus floor, type 2 involved roots that touched the sinus floor, and type 3 involved roots that extended below the sinus floor. In conclusion, when the relationships between the posterior teeth and the sinus floor were evaluated according to sex and sinus position, no significant difference was found between the right and left sides, but a statistically significant difference was found between males and females.

- **Kang SH et. al. [35] (2015)** conducted a study to evaluate the vertical and horizontal relationships between the maxillary sinus floor (MSF) and the root apices of maxillary posterior teeth with various root configurations

and the distance from the root apex to the MSF and the buccal cortical plate. In this study 2159 apices in 1056 teeth were evaluated and the conclusion drawn was that the proximity of posterior teeth to the MSF and buccal bone thickness differed according to tooth type and root numbers. The apices of the mesiobuccal roots of the second molars had the shortest mean vertical distance to the MSF and the thickest mean horizontal distance to the buccal cortical plate among the buccal roots of 3-rooted molars. Prior knowledge of the position of the root apex relative to the adjacent anatomic structures is beneficial for preoperative treatment planning and the prevention of complications.

- **Asthana G et. al. [(36)] (2015)** conducted research with the aim to assess the relationship between the maxillary sinus floor and the maxillary molar root tips using CBCT. A total of 30 maxillary first molars and 30 maxillary second molars from 17 patients were included. This research revealed that the distance between sinus floor and root tip was longest for the first molar mesiobuccal root and shortest for the second molar distobuccal root. 9.4% of all root apices were closely related to the maxillary sinus floor by close contact or by protrusion into the sinus. In the first molars, palatal roots were always located closer to the sinus than buccal roots. While in the second molars, buccal roots were located closer to the sinus than palatal roots. The measurements obtained in the coronal planes were lesser than those in the sagittal planes for all roots. This is explained by the fact that the shortest distance from the apex to the sinus on the coronal image was mostly taken in an oblique direction, but the corresponding sagittal section

was perpendicular relative to the coronal section, explaining the higher values of measurements obtained with sagittal images.

- **Roque-Torres GD et. al. [37] (2015)** carried research comparing the quantitative and qualitative data obtained from various imaging modalities in order to assess how the maxillary sinus and the apices of posterior teeth relate to one another. The study sample consisted of 31 males and 78 females, aged 22 years on an average (range: 18–30), irrespective of their social status, ethnicity, or other socioeconomic attributes. A pair of CBCT and panoramic radiographs that were taken within a month of each subject's dental record were chosen. The sinus floor and the root apices of the maxillary posterior teeth were shown in each pair. The same Orthopantomography equipment created all of the digital panoramic radiographs using the same parameters, and they were all digitally recorded. For both the qualitative and quantitative assessments, every root of the first and second premolars as well as the first and second molars were utilized. Over a period of three years, three oral radiologists served as research assessors and evaluated the topographic connection of each root to the maxillary sinus floor in both panoramic and CBCT pictures. They used the same scoring technique as explained by Sharan and Madjar (2006) to blindly assess the photos in low light. There are four possible outcomes: zero, where the root's apices are not in contact with the sinus's cortical borders; one, where they are; two, where the root is projected lateral to the sinus cavity and its apices are in contact with the sinus's cortical borders; three, where the apices are projecting within the sinus cavity; and four,

where the maxillary sinus has a buckle that goes around the tooth's root and its apices and are just in contact with the sinus's cortical borders. This study reveals where roots are in touch with or above the maxillary sinus floor, there is little connection between panoramic radiography and CBCT. In cases when roots lie below the floor of the maxillary sinus, a significant degree of agreement was found.

- **Teng YH et. al. [38] (2015)** conducted research to evaluate the topographic relationship between maxillary sinus and upper molar root apices by cone beam computed tomography (CBCT) and to provide evidence for dental treatment that would get the upper molars involved. This study included 98 sides of maxilla, left and right in 53 non symptomatic subjects. The vertical distances from the root apices of maxillary molars to the floor of maxillary sinus were assessed by CBCT. The mean vertical distances were analysed with interval estimation. 98 sides could be classified into 4 categories according to the relationship between maxillary sinus and upper molar root apices. The distance for bucco-distal root apex of first maxillary molar was found to be the shortest one, i.e. 0.44+_0.61 mm. it was found that the maxillary molars, particularly the second molar were closest to the sinus floors.

- **Georgiev T et. al. [39] (2015)** conducted research to evaluate the connection between the maxillary sinus floor and the apices of the rear teeth. A retrospective randomized examination of 245 maxillary scans, 465 sinus scans, and 960 tooth scans pertaining to the link between the teeth

and the maxillary sinus were all part of the study. Canines, premolars, and molars were included in the measurements, which assessed the distance between the root apices and the maxillary sinus floor. Each of these teeth were separated into four groups: Group I consisted of teeth that were spaced 2-4 mm from the maxillary sinus; Group II was made up of teeth that were 0-2 mm from the sinus (but not visible); Group III was made up of teeth that had apices that breached the sinus 0-2 mm; and Group IV was made up of teeth that had apices that breached the sinus 2-4 mm. Of the 218 teeth that were examined. 143 were dangerously close (0–2 mm): the root apices of 14 of the teeth protruded up to 2 mm into the maxillary sinus, and one tooth even had a 4-mm breach. A higher risk of unintentional sinus perforation occurred when first molars (a total of 258 teeth studied) were extracted: 173 teeth were found to be in hazardous proximity, 50 teeth protruded up to 2 mm into the sinus, and 5 teeth pierced up to 4 mm into the sinus.

- **Tian X. M. et al. [(40)] (2016)** conducted a study using Cone-beam computed tomography images of 848 patients and reconstructed it to evaluate the position of the posterior roots relative to the sinus floor and quantify the distances between posterior root apexes and the adjacent border of the sinus floor. Measurements were taken for each root, and data were correlated with age. This study shows the first premolar was always farther (-6.0 to 23.2 mm) and the second molar mesio-buccal root was closest (-7.0 to 15.5mm) to the border of the maxillary sinus floor. The root protruding into the sinus was rare in the first premolar and dominated in

the first molar palatal root (-1.3 to 17.8 mm). Age significantly influenced the average distance and the frequency of root above the maxillary sinus floor. It also reveals that the mean distances of all roots of maxillary premolars and molars to the adjacent border of the sinus floor increased with increasing age. The root was closer to the border of the maxillary sinus floor before the age of 20 and farther after the age of 60.

- **Estrela C et. al. [41] (2016)** conducted a retrospective analysis of CBCT scans selected from the database of a private radiologic centre to evaluate the anatomical relationship between posterior teeth root apices and maxillary sinus floor (MSF). 1200 maxillary posterior teeth were evaluated (300 first premolars, 300 second premolars, 300 first molars and 300 second molars). 266 premolars were single-rooted and 334 were bi-rooted. All molars were tri-rooted teeth. This study concluded that roots of the maxillary molars showed greater proximity with the MS when compared with premolars; the thickness of the cortical bone of the MS floor in the region closest to the apex and furcation area was found to be similar only for premolars.

- **Fry RR et. al. [42] (2016)** conducted a study to examine the relationship between the roots of the maxillary posterior teeth and the maxillary sinus, as well as the distance between the roots and the sinus floor, as well as the thickness of the bone between the roots and the alveolar cortical bone, utilizing a Denta scan. 50 individuals with bilaterally erupted maxillary first premolars to maxillary second molars in a normal eruption. Four types

of Denta scan® pictures are categorized based on the vertical connection between each tooth root and the maxillary sinus (Jung 2009). It concluded that it was more typical for the buccal root of the maxillary molars to project into the maxillary sinus. Mesiobuccal root of the first molar and palatal root of the second premolar were identified to be among the roots of the maxillary posterior teeth that were closest to the maxillary sinus floor. When compared to other maxillary posterior tooth roots, the maxillary first premolar and maxillary first molar had considerably less bone thickness on the buccal face of the root.

- **Nino-Barrera J. L. et al. [43] (2017)** conducted a study to assess the relationship between the maxillary sinus floor and the upper posterior root tips in the Colombian population by using CBCT. The images from patients who attended Sonria Radiology Center and the Universidad El Bosque School of Dentistry in Bogota, Colombia, from January to November 2015 were taken. The results showed that the palatal root of the maxillary first molar was most frequently found inside the antrum (12.5%) and the least frequently found was the first bicuspid palatal root (0%) in Colombian population.

- **Ahn NL et. al. [44] (2017)** conducted a study between 2011 and 2014 in Korea, and patients with unobscured pretreatment CBCT images and cephalometric radiographs were included in this research. The study included 118 patients. The sample consisted of 63 male and 55 female subjects**.** The study concluded male, older age, hyperdivergent skeletal pattern, and large gonial angle groups had significantly closer distances

between maxillary root tips and the sinus floor or more protrusion of the roots into the sinus. The intrusion of the maxillary molars in those situations may be difficult and slow because of the pneumatized maxillary sinus.

- **Maxood M. et. al. [45] (2017)** conducted research to determine the distance between the roots of the maxillary posterior teeth and the sinus floor, as well as the thickness of the bone separating the roots from the alveolar cortical bone, by utilizing a Denta scan. Fifty individuals with bilaterally erupted maxillary first premolars to maxillary second molars that are normally erupted are included in the study samples using Denta scan® pictures. Denta scan pictures may be categorized into four groups depending on the vertical connection between each tooth root and the maxillary sinus (Jung, 2009). Measured and examined is the length of the sinus floor between the root and the alveolar cortical plate as well as the thickness of the bone between the two. It was more typical for the buccal root of the maxillary molars to project into the maxillary sinus. Mesiobuccal root of the first molar and palatal root of the second premolar were identified to be among the roots of the maxillary posterior teeth that were closest to the maxillary sinus floor. When compared to other maxillary posterior tooth roots, the maxillary first molar and maxillary first premolar had considerably less bone thickness on the buccal face of the root.

- **Haghanifar S. et al. [46] (2018)** conducted a study using the CBCT scans of 160 patients who referred private oral and maxillofacial radiology centre. All CBCT scans were taken and examined Images and the vertical

relationship of maxillary molars roots with the sinus floor and the divergence angle of the roots of the molars were examined and evaluated using Dental Ondemand 3D software. The study shows that prevalence of class 2 relationship of maxillary 1st molar that is root is projecting laterally on the maxillary sinus was found to be most common. Thus, found to be act far with other studies.

- **Katti G et. al. [47] (2018)** conducted research to Assess the relationships between the roots and furcation of the maxillary first molar to the floor of the maxillary sinus. A total of 36 patients, with a mean age of 36.94 ± 16.33 years, participated in the research. The patient's age ranged from 10 to 72 years old, with 10 being the least and 72 being the most. In the research, there were eighteen males and eighteen women. There are 24 maxillary left first molars and twenty-seven maxillary right first molars in the research. Twenty-two unilateral and fourteen bilateral first molar teeth were examined, based on the 36 patients' CBCT images that were available. As a result, the research comprised 50 maxillary first molars in total. The study found that while the majority of roots were not in contact with the maxillary sinus, a significant number were either in contact with it or were penetrating into it. Class 3, which is perforating into the sinus, included a total of 14 (28%) mesio buccal roots, 8 (16%) disto buccal roots, and 5 (10%) palatal roots. Of the 18 scans, the mean distance from the sinus floor for the furcation was less than 5 mm (3.64% ± 1.14) and the rest was greater than 5 mm (6.19% ± 2.63).

- **Makris LM et. al. [48] (2018)** performed a study to evaluate the relationship between the apices of maxillary posterior teeth (second premolar, first molar, and second molar) and the maxillary sinus floor (MSF) and maxillary cortical bone (MCB) Using cone beam computed tomographic (CBCT) scanning, 1660 roots from 678 teeth were analysed to find the shortest distances between the root apex and the maxillary bone's buccal and palatal cortices as well as between the root apex and maxillary sinus floor. The analysis revealed that the mesiobuccal root of the maxillary second molar was the root closest to the maxillary sinus floor, while the maxillary first molar was the tooth closest to the maxillary cortical bone. Second premolars were farther from both the maxillary cortical bone and maxillary cortical bone than were molars.

- **Tafakhori Z et. al. [49] (2018)** conducted research to evaluate the distance between posterior teeth and the maxillary sinus floor in patients of Rafsanjan, Iran. The study evaluated 35 CBCT radiographs of patients over 20 years old and 73 teeth of 35 selected CBCT radiographs were evaluated. Out of the 35 patients, 20 (57.1%) were men and 15 (42.9%) were women. Vertical relationships between all roots of posterior maxillary teeth and the maxillary sinus floor and classified them as described by Didilescu et al. The distance between the maxillary sinus floor and the distobuccal, palatal, and mesiobuccal roots was found to be mostly type 1, 0, and 2, with a prevalence rate of 50%, 37.5%, and 43.8%, respectively, in the left side sample. The distance between the maxillary sinus floor and the mesiobuccal, palatal, and distobuccal (37.5%) roots of

the right side first molars was primarily type 0. There are no appreciable differences between men and women, according to this study.

- **Makris LM et. al. [50] (2018)** carried research to measure the distance in a population from southeast Brazil using cone beam computed tomography (CBCT) images between the root apices of the maxillary posterior teeth and the maxillary sinus floor (MSF) as well as between those root apices and the buccal and palatal maxillary cortical bone (MCB). A total of 113 CBCT images, totalling 226 maxillary sinuses, were randomly selected. Bilateral second premolars, first molars, and second molars with complete roots restored or not were required for inclusion. If the patient satisfied any of the following exclusion criteria, their images were removed: they had to be younger than 21 years old; they had to have an endodontic infection; they had to have had periapical surgery on their posterior teeth; they had to have had surgery in the maxillary sinus area; they had to have had orthognathic surgery; or none of the teeth that needed to be examined were present. The maxillary first molar was the tooth closest to the MCB, according to the research, whereas the mesiobuccal root of the maxillary second molar was the root closest to the MSF. Compared to molars, second premolars were located further from the MCB and MSF.

- **Gu Y et. al. [51] (2018)** carried research to evaluate both the relationship between the maxillary posterior teeth and maxillary sinus floor, and the influence of adjacent teeth loss on the distance between the maxillary posterior roots and maxillary sinus floor. Images from 1011 Chinese

patients who had cone-beam computed tomography scans were taken. Three types of relationships were identified between the maxilalary posterior teeth and the MSF: Type OS, where the root apex extends below or outside the MSF, Type CO, where the root apex contacts the MSF, and Type IS, where the root apex extends above or within the MSF. The apices of the maxillary posterior roots and the MSF were measured for the minimal vertical distances. This study also correlated vertical distances with age and gender. With varying degrees of neighbouring tooth loss, the distances between the MSF and the maxillary posterior root apices were measured. Of all posterior root apices, type OS was the most prevalent connection. The mesiobuccal roots (MBRs) of the maxillary second molars (MSMs) and the palatal roots (PRs) of the maxillary first molars (MFMs) had the greatest Type IS percentages, at 21.6% and 24.8%, respectively. With the exception of the MSMs' premolar roots and PRs, the frequency of Type IS declined with age. The mesiobuccal roots of maxillary second molars were the closest to the maxillary sinus floor (0.8 ± 2.5 mm), with the palatal roots of maxillary 1st molars (1.4 ± 3.4 mm) and the distobuccal roots of maxillary second molars (1.3 ± 2.7 mm) following closely behind. There was a rise in the number of root apices that extended outside the maxillary sinus floor and a drop in the number that extended inside or made contact with the maxillary sinus floor, with advancing years.

- **Kilic C et. al. [52] (2019)** conducted a study with the aim of to assess the relationship between the maxillary sinus floor and the maxillary posterior teeth root tips using dental cone-beam CT. Dental cone-beam CT was used

to investigate 87 right and 89 left maxillary sinus areas from 92 individuals. An expert in oral and maxillofacial radiology examined the images and concluded that the distance between sinus floor and root tip was longest for the first premolar root tip and shortest for the second molar Bucco distal root tip for both right and left sides. No statistically significant differences were found between the right and left side measurements or between female and male patients (P>.05)

- **Razumova S. et. al. [53] (2019)** performed a study to Evaluate the relationship between the maxillary sinus floor and the root apices of the maxillary posterior teeth using cone-beam computed tomographic scanning. In this research 325 CBCT scans of patients aged 20–70 years were analysed. Patients were divided into three age groups: young age group (20–44 years), middle age group (45–59 years), and elderly group (60–70). The distance from the MS floor and the root apices of posterior teeth was measured in each group. The relationship between the MS and the posterior roots was also recorded according to Kwak classification. The results were analysed by IBM statistic SPSS. This study concluded that shortest distance to the floor of Maxillary sinus was recorded for the mesiobuccal root of the second molar and the longest distance for the palatal root of the first and second molars. No statistical differences were found between age groups ($P > 0.01$).

- **Kumar P et. al. [54] (2019)** conducted study to assess the relationship between maxillary sinus floor and maxillary posterior teeth using CBCT.

The database was searched for 50 bilateral maxilla CBCT scans, removing subjects with pathologies like cysts, tumours, bone loss in the maxillary posterior teeth region, evidence of a fracture in the maxillary posterior teeth region, and errors and artifacts obstructing visibility of maxillary structures. Accordingly on cross-sectional images, vertical relationships were divided into four categories. Type 0: Location of maxillary sinus floor above root tip, Type 1: maxillary sinus floor touches the root apex, Type 2: maxillary sinus floor interposed between roots, Type 3: Apical protrusion over the maxillary sinus floor, Type 1 and type 3, were further classified into three types, Type B: maxillary sinus floor lowest point located on the buccal root, Type BP: maxillary sinus floor lowest point located between the buccal and palatal roots, Type P: maxillary sinus floor lowest point located on the palatal side of the palatal root. The results of this study showed that type 0 was more prevalent in maxillary first premolars, whereas type 3 was more prevalent in maxillary first and second molars. When comparing the maxillary sinus floor between the right and left sides for the mean distance of several maxillary posterior tooth roots, there was no discernible difference. The right maxillary first premolar's palatal root was located farthest from maxillary sinus floor, whereas the right second molar's mesiobuccal root was closest to it.

- **Tang L et. al. [(55)] (2020)** carried out study to analyse the distance and relation between the root apex of maxillary posterior teeth and the maxillary sinus floor (MSF) and whether they altered with age using cone-beam computed tomography (CBCT) images. Totally 221 patients were

included in this study (males: 51.6%, females: 48.4%, age: 21–84 years, average 47.8 ± 13.9 years). A total of 316 sinuses, 618 teeth, and 1416 roots were analyzed, among which 219 were second premolar, 226 were first molar, and 173 were second molar Four types of relationships were identified based on measurements of the distance and angle between the root apex and the maxillary sinus floor. This study reveals that in the maxillary first molar, the highest percentage of root protruding into the sinus was in palatal root (6P), 11.8%, which was also the highest among all roots. The corresponding percentage in mesiobuccal (6MB) and distobuccal (6DB) root was 3.5% and 2.6%, respectively. The results indicated that the mean distance under 40 years old from the root apex to the maxillary sinus floor was substantially smaller than that of the older age groups ($P < 0.05$). However, there was no discernible variation in the comparable mean distance for those over 40. This also shows that gender and side had no effects on the mean distance from the root apex to the maxillary sinus floor.

- **Anter E et. al. [(56)] (2019)** carried research to evaluate on a sample of the Egyptian population, the distance between the roots of maxillary molars and the maxillary sinus floor, using CBCT. A total of 87 CBCT scans representing 135 maxillary first molars, 168 maxillary second molars, and 107 maxillary third molars were obtained from adult Egyptians (58 females and 29 men). Using cross-sectional CBCT images, the vertical relationship between MSF and the dental roots under examination was evaluated using the 2009 Jung classification. The first molars in all mesio-buccal "MB", disto-buccal "DB", and palatal "P" roots of the teeth under

examination had the highest prevalence of class 0 in the three roots; second molars in all MB and DB roots had the highest prevalence of class 3, and third molars in all P roots had the highest prevalence of class 2. Finally, third molars in all DB and P roots had the highest prevalence of class 1 and the highest prevalence of class 3 among P roots. Just the roots of the first maxillary molars showed a substantial adverse connection with age in terms of vertical relationship classes. In the third molars, men exhibited a larger frequency of Class 2 and Class 3 and females a higher prevalence of Class 0 and Class 1.

- **Hameed K.S. et al. [57] (2020)** conducted a study including 200 patient's data (100 male and 100 female) taken from archives in the Al-Qassim population of Saudi Arabia using CBCT. The linear distance of the root apices to maxillary sinus floor were measured from maxillary posterior teeth. On CBCT cross sectional images, the kwak et al. criteria were used to assess the horizontal and vertical relationship between the root apices of maxillary posterior teeth and the maxillary sinus floor. This study concludes that type 2 vertical relationship (29-70%) and horizontal relationship of type 2H (28-67%) is at high frequency with the maxillary floor sinus. No significant correlation is seen when compared to the male and female groups.

- **Pei J. et al. [58] (2020)** conducted a study including 212 patient demographics (sex and age) and cone-beam computed tomography data regarding the relationship between molar roots and the maxillary sinus were obtained. However, the distance between maxillary molar roots and the maxillary sinus increased with age. The mesio-buccal root of the

second molar was nearest to the maxillary sinus. The most common relationship types I involved absence of root contact with the sinus border and presence of a maxillary sinus cross-section above the root apex. Sex and side did not significantly influence the distance between maxillary molar roots and the maxillary sinus.

- **Aktuna Belgin C et.al. [59] (2020)** conducted a study which aims to analyse alveolar bone height (ABH) in the maxillary molar area according to the anatomical relationship between maxillary sinus and maxillary molar teeth via cone beam computed tomography images. The CBCT images of 330 patients (166 female, 164 male) between the ages of 18 and 72 years (mean 36.09 ± 9.40 years) who were meeting the criteria were randomly selected. The mean ages of the female and male groups were 35.83 ± 9.46 years and 36.35 ± 9.36 years, respectively. In 330 patients, 660 maxillary first molar (M1), and 648 maxillary second molar (M2), a total of 1308 maxillary molars were evaluated. Following measurement, the locations of the maxillary molar teeth relative to the maxillary sinus were divided into four groups [13]. Type 1: The apex of all roots is not in touch with the lowest margin of the maxillary sinus floor. Type 2: The maxillary sinus is between the buccal and palatal roots. Type 3: One or more roots extend into the maxillary sinus. Type 3 was classified into four subclasses. Type 3a: Only the buccal root is in the sinus; type 3b: Only the palatal root is in the sinus; type 3c: All roots are in the sinus; and type 3d: The fused root is in the sinus. Type 4: All roots are found on the buccal or palate side of the sinus. According to the categorization of the anatomical relationship between maxillary molar teeth and maxillary sinus, type 3 was the most

prevalent, followed by types 1 and 2, and type 4 was the most unusual among all maxillary molars. This study also found that the patients had the fewest root protrusions into their maxillary sinuses.

- **Junqueira RB et. al. [60] (2020)** conducted research to assess the connections between the MS floor and the root apices of maxillary posterior teeth. Cone beam computed CT images of 851 posterior teeth (1969 roots) were assessed by three oral radiologists. The most superior point of the apex was seen on the parasagittal portions of each root, which were examined separately. Following a qualitative assessment, each root was given a proximity score: 1, if the root invaded the MS; 2, if it was in close touch with the MS floor; 3, if it had no connection to the MS; and 4, if the root was in quantifiable proximity to the MS. The distance to the MS floor was measured (quantitative analysis) for roots with a score of 4. There were no changes in the distances to the MS between the various roots of the same tooth or between the posterior teeth on the right and left, according to the quantitative study. The first molar, second premolar, and first premolar were arranged in order of proximity to the MS, starting with the second molar.

- **Son WS et. al. [61] (2020)** conducted research to assess the vertical connection, in terms of an anterior overbite, between the maxillary posterior teeth (MPT) and the maxillary sinus floor (MSF). This retrospective analysis comprised Korean patients who had undergone CBCT and were at least 20 years old. Three groups of patients were created based on the presence of an anterior overbite. Patients with an

anterior overbite of less than 0 mm were included in the open bite group (OBG), those with an overbite of 0–3 mm in the normal overbite group

- (NBG), and those with an overbite of more than 3 mm in the deep bite group (DBG). Based on age and gender, thirty patients were randomly assigned to each group. With cone-beam computed tomography, the distances and vertical connection between the MSF and the MPT were examined. It was determined if the vertical connection between the two was beneficial or unfavourable for the posterior teeth to encroach. The vertical distance between the MSF and the MPT is associated with an anterior overbite. The vertical relationship and distances between the MSF and the MPT were investigated using cone-beam computed tomography. It was ascertained whether or not the posterior teeth may invade due to the vertical relationship between the two.

- **Li L et. al. [(62)] (2020)** conducted research to assess the anatomical connection between the maxillary sinus and the maxillary molars using cone beam computed tomography (CBCT). Using CBCT scans, a database of maxillary molars from 91 adult individuals was created. CBCT was used to measure the internal angle, the breadth of the alveolar bone, and the separation between the root apex and the maxillary sinus wall. An analysis was conducted on the vertical connection between the maxillary sinus and the maxillary molars. The vertical relationships in the direction of the axis of the tooth between the maxillary molars and the inferior wall of the maxillary sinus were evaluated and divided into 5 categories (type I, II, III, IV, V) according to a revised standard stated by the Yoshimine et al. The maxillary third molar's internal angle is 17.2 ± 11.5°. The third molar's

alveolar bone width measures 8.2 ± 1.7 mm. In the first and second molars, type III, IV, and V relationships were the most prevalent. The first and second molars were where Type V and I were most commonly found. Compared to the first molar, the second molar has a bigger inner angle. The third molar had the biggest average alveolar bone width, whereas the maxillary first molar had the smallest.

- **Kaushik M. et. al. [(63)] (2020)** conducted investigation to examine the vertical distance between the maxillary posterior roots and the neighbouring maxillary sinus floor (MSF) in the Indian population by using cone-beam computed tomography. Correlating the data with gender and age was the secondary goal. The closest distance between the neighbouring MSF border and 452 maxillary posterior teeth was measured. Three categories were created using the data. Group OS comprised root apices not touching the MSF, Group CO comprised root apices contacting the MSF, and Group IS comprised roots of maxillary posterior teeth projecting into the sinus. Age and gender were found to be linked with the collected data. When compared to the root apices of first premolars, the second premolars' vertical distance from the MSF was substantially less. There was a statistically significant difference in the vertical distance between the buccal roots and palatal roots (PRs) of the first molar from the MSF. The majority of posterior dental roots (Type OS) were found below the MSF boundary. PRs of maxillary first molars were most commonly observed to be Type IS (29.12%). With advancing years, Type IS was less common. Males were observed to have a greater distance than females between the posterior root apices and the neighbouring border of the MSF.

- **Sengupta N et. al. [64] (2020)** conducted research to ascertain the anatomical connection between the root apices of maxillary posterior teeth and the floor of the maxillary sinus, using CBCT. Using internet databases like PubMed, Google Scholar, and others, a thorough and methodical search of the literature was carried out. Studies that used CBCT to offer information on the anatomical connection between the root apices of maxillary posterior teeth and the maxillary sinus floor were chosen. In most researches it was revealed that the maxillary sinus lengths were largest near the maxillary first premolars and smallest near the buccal roots of the maxillary second molars. Regardless of the CBCT plane, the palatal roots of first premolars were consistently found nearer the maxillary sinus than the buccal roots. Compared to the roots of first premolars, the typical location of second premolar roots was much closer to the maxillary sinus. The buccal root apices of the first and second maxillary molars were seen to be closer to the maxillary sinus floor than the palatal root apices.

- **Yildirim TT et, al. [65] (2020)** conducted research to determine the relationship between root apices and maxillary sinus wall, and to analyse pulpoapical conditions of 2nd premolars, 1st molars, 2nd molars, 3rd molars using cone beam computerized tomography (CBCT). This study was a retrospective study that included CBCT images of 1000 maxillary sinus with 500 subjects. The association of each tooth with sinus floor and pulpoapical status were categorized. The association among gender, age, lateralization of sinus cavity was also evaluated. These are the categories: Classes I and II: The apex of the buccal and palatal roots was not in touch

with the sinus floor, and they were in contact with it. Class IV: Palatal root apex was pierced into the sinus cavity over the maxillary sinus floor; Class V: Both buccal and palatal root apexes were penetrated into the sinus cavity over the maxillary sinus floor. Class III: The buccal root apex was entered into the sinus cavity over the maxillary sinus floor. According to the study, there are no appreciable variations in the pulpoapical state of teeth between the left and right sides or between genders. The maxillary sinus is closest to teeth in the second molar position. Among all assessed teeth, Class I pulpoapical condition is the most prevalent.

- **Motiwala M. et. al. [(66)] (2021)**: conducted a study with 60 CBCT scans with 1066 roots of maxillary posterior tooth to assess the correlation between age, gender, and bilateral jaw symmetry in relation to the roots of the maxillary posterior teeth and the maxillary sinus floor in a vertical manner. It included males and females of Pakistani descent, aged 20 to 65, with CBCT scans that showed their maxillary sinuses and their right and left maxillary first premolars to maxillary second molars erupted regularly. This study concluded that the most common tooth root protruding in the sinus was found to be the mesio-buccal root of the 2nd molar, followed by palatal roots of the 1st molar. The most distant maxillary tooth root from the sinus was the buccal root of 1st and 2nd premolars. No significant difference was found in terms of gender and sides ($p \geq 0.05$).

- **Regnstrand T et. al. [(67)] (2021)** conducted a study to describe the relationship between maxillary sinus (MS) and upper teeth based on cone beam computed tomographic scans (CBCT). A retrospective analysis of

cone beam computed tomography (CBCT) scans was carried out with a total of 380 scans. The study revealed that 1st and 2nd upper molars are the teeth most often in a close relationship to MS. The root in closest relationship to MS is the mesiobuccal root of the 2nd molar followed by the distobuccal root of the 2nd molar and the palatal root of the 1st molar. Upper canines need to be taken into consideration for their potential sinus relation, surely when investigating sinusitis with a possible dental cause.

- **Al-Saedi A et. al. [(68)] (2021)** conducted a study that aims to evaluate the type of relationship between roots of maxillary posterior teeth and maxillary sinus. In this research a total of 148 individuals (62 men and 86 females) were assessed using cone beam computed tomography. 1052 teeth were evaluated. The sample of population had an age range between 18-63 years (average age 32.1 years). There are four types of relationships between root tips and maxillary sinus floor: type 0, type 1, and type 2. In this research, they examined type 3 vertical linear distance and analysed the distribution of connection types across age groups. Type 0 was the most prevalent in maxillary first molars, accounting for 43.3%, 39.8%, and 38.6% for mesiobuccal, distobuccal, and palatal roots, respectively. In this study, it was also noticed that (type 0), where root apices are locating away from MSF, increase in occurrence with increasing age, indicates a decrease in sinus size in older age groups with statistically significant difference (P-value).
- **Shrestha B et. al. [(69)] (2021)** conducted a study by using cone-beam computed tomography (CBCT) to assess the distance between posterior root apices and the maxillary sinus floor (MSF), as well as the frequency

of roots contacting or projecting through it. The study comprised 100 participants with various vertical and anteroposterior skeletal development patterns. CBCT images were used to determine the distance between posterior root apices and MSF, as well as assess the frequency of roots contacting or protruding through it. In skeletal class II, the palatal roots of the first and second molars were substantially closer to the MSF than in class III ($P<0.05$). The high-angle group had the most roots contacting or extending into the maxillary sinus (49.8%). Skeletal class III had the lowest proportion (28.3%), while class II had the largest proportion (50.3%). This research also revealed that males showed shorter distances from the posterior root apices to the MSF and more roots protruding or contacting it compared to females. Males tend to have more roots touching or protruding through the MSF than women, possibly due to physical growth differences. The anatomical variations analysed in this study do not appear to be gender dependent. There were no statistically significant differences in the distance from the maxillary posterior root apices to the MSF between the left and right sides There were no statistically significant differences in age among the groups.

- **Robaian A et. al. [(70)] (2021)** conducted research to analyse using CBCT the relationships between the maxillary molar roots' divergence angle and their closeness to the maxillary sinus floor. The evaluation included the vertical relations between the maxillary molar root apices and the maxillary sinus floor (MSF), and the root divergence was measured from the root apices to the floor of the pulp chamber. In this research Kwak's classification system is followed for root apex and maxillary sinus floor

relationship. A total of 100 images, comprising 316 permanent maxillary first and second molars, were examined. The result of the vertical relationship between the root apex and maxillary sinus floor types revealed a higher prevalence of the maxillary sinus floor Type II relationship (39.6%), followed by the maxillary sinus floor Type I relationship (31.3%). Considering the difference between the sexes, in general, except type I, all other maxillary sinus floor relationship types were found to be more in males than in females. Regarding the age groups, generally, the prevalence of Type I, II and V maxillary sinus floor relationships was higher in the 28-year-old group than in the less than 28-year-old group.

- **Ragab MH et. al. [(71)] (2021)** used cone beam computed tomography (CBCT) on a subgroup of Egyptians to assess the apices of the maxillary posterior teeth's placement in relation to the maxillary sinus floor (MSF), the symmetry between the two sides, and any potential differences between males and females. A total of 120 individuals (240 second premolars, 480 first and second molars, and 1680 roots) had CBCT pictures taken. Three categories were created based on how close the roots of the maxillary second premolar, first and second molars, and other teeth were to the sinus floor: within the sinus floor (IS), touching the sinus floor (TS), and outside the sinus floor (OS). Both the symmetry and the relationship between the distance and gender were examined. This research reveals that type OS was the most common frequent of all roots apices to the MSF and it was the highest in the maxillary 2nd premolars (MSPs). Type IS was highest in the mesiobuccal roots of the maxillary second molars and the palatal roots of the maxillary 1st molars. No significant difference is found between

males and females in all posterior teeth and between the two sides as well.

- **Balchandani U et. al. [72] (2022)** conducted a study to evaluate proximity of the maxillary sinus floor and the roots of the maxillary first molar teeth. The three categories were identified by evaluating the vertical relationship between the maxillary first molar teeth and the maxillary sinus floor in both the coronal and sagittal CBCT planes at the same time. type IS: The root tips that protrude past or inside the MSF Type CO: The maxillary sinus floor and the root in contact. The root that extends outside or below the sinus floor is Type OS. This evaluation states that 60% of the maxillary first molar roots are at the proximity with the maxillary sinus lining (1500 samples had a maxillary first molar root that was either perforating or nearing the sinus lining).

- **Altaweel AA et. al. [73] (2022)** performed a study to evaluate the relationship between maxillary posterior teeth and maxillary sinus floor in a population of the western area of Saudi Arabia, and if age, gender, and size may affect such distance. 539 cone-beam computed tomography (CBCT) radiographs of individuals older than 20 were assessed in this retrospective research. Group I (20–30 years), Group II (31–40 years), Group III (41–50 years), and Group IV (more than 50 years) were the age categories into which the patients were split. The vertical distance between the posterior maxillary root and the maxillary sinus was measured using CBCT coronal and sagittal images, and the posterior maxillary root was classified based on how close it was to the maxillary sinus. The second molars' buccal roots are the closest to the sinus floor in the research population. The risks connected with the extraction and implantation of

maxillary molars are higher in younger patients as the distance between posterior maxillary teeth and maxillary sinus was primarily type 1 (0–2 mm). This research also concludes that Gender and size did not significantly affect the distance between maxillary posterior root and maxillary sinus. However, there was a significant increase in this distance with increased age.

- **Lee HS et. al. [(74)] (2022)** performed study on the closeness of maxillary molar roots to their underlying cortical bone surfaces and the maxillary sinus. The study included 151 patients (91 males and 60 women). The study comprised 298 maxillary first molars and 269 maxillary second molars from participants ranging in age from 17 to 81 years. All teeth were analysed by measuring the distance from the adjacent buccal or palatal cortical plate to the root apex and to the centre of root at 3.0 mm from the apex, and the difference in the vertical level from the sinus floor to the root apex. The vertical relationship between the maxillary molar apex and maxillary sinus was categorized as follows: type I, protrusion of the root apex into the sinus; type II, the root apex at the same vertical level as the sinus floor; and type III, location of the root apex below the sinus floor.

- **Swathi KV et. al. [(75)] (2022)** conducted research to assess the vertical relationship between the posterior teeth in the maxillary arch with the floor of the maxillary antrum, using Cone Beam Computed Tomography (CBCT) in a South Indian population. This study involved a retrospective inspection of 50 right or left maxillary sinuses in tangential and panoramic sections. The maxillary antral floor's contour forms were traced, and the

vertical distance between them and the maxillary posterior root apices was measured. There were four different patterns of the maxillary antral floor with the root apices of the maxillary posterior teeth visible. Type 0: The maxillary posterior teeth were not in touch with the maxillary antrum's floor, Type 1: The root apices of the maxillary posterior teeth are in contact with the maxillary antral floor, Type 2: The maxillary antral floor is observed to protrude between the roots of the maxillary posterior teeth, Type 3: The roots of the maxillary posterior teeth are found to be consistently projected by the maxillary antral floor, The most prevalent kind was type 0 (46%) and was followed by Type 1 (24%), Type 2 (20%), and Type 3 (10%).

- **Mir HA et. al. [(76)] (2023)** conducted a study by utilizing cone beam computed tomography (CBCT) to ascertain the link between the maxillary sinus and the mesiobuccal root of the maxillary first molar. A total of 142 CBCTs were examined. There were 142 first molars on the right side and 142 on the left, as there is one first molar on each side. The age's mean, standard deviation, and standard error of mean were 40.38 + 17.90, 1.50. This study revealed no significant difference between left and right side. The mesiobuccal root of the maxillary first molar and the maxillary sinus have a major association. The study demonstrates that the maxillary mesiobuccal molar root is almost in close proximity with the sinus floor in dentate healthy people.

- **Nair AK et. al. [(77)] (2023)** conducted a study to assess the association between the maxillary posterior teeth's periapical status and its proximity

to the maxillary sinus floor in the event of accidental sinus diseases using cone-beam computed tomography (CBCT). The association between the maxillary posterior teeth and sinus floor was analysed retrospectively using CBCT scans of 118 individuals, ranging in age from 18 to 77. The periapical status was determined using the CBCT periapical index, and the vertical relationship was assessed using modified Kwak's classification. SPSS statistics software was used to conduct the statistical analysis. The existence of diseases was assessed in 108 left maxillary sinuses and 118 right maxillary sinuses (of which, in 9 cases, only the left side maxilla was taken into consideration for the investigation due to the absence of right-side posterior teeth). This study established a positive association between periapical disease status of maxillary posteriors and maxillary sinus mucosal thickening with evidence of 50.2% of the sinuses associated with teeth with periapical pathologies, also the maxillary second molar was found close to the sinus compared to other posterior teeth.

- **Abdulwahed A et. al. [(78)] (2023)** conducted research to assess the average distance and variations between the patients' age and gender and the maxillary sinus floor (MSF) and posterior maxillary teeth. A total of 124 maxillary sinuses and 496 posterior maxillary teeth in 62 CBCT pictures were randomly selected for this cross-sectional study conducted among Saudi citizens. The study included CBCT scans of posterior maxillary teeth that were fully formed and undistorted; in contrast, scans from patients under the age of twenty, teeth with root resorption, teeth with periapical radiolucency, teeth missing posteriorly, and cases with large cysts or tumours were not included. This investigation demonstrated the frequent

relationship between the sinus floor and the apex of the second molar mesiobuccal root. This study showed that the second molar mesiobuccal root apex is frequently related to the sinus floor. No significant relation was found between the apices of the left first and second molar roots and the floor of the maxillary sinus concerning gender.

- **Aguori EA et. al. [(79)] (2023)** conducted research to evaluate the relationship between proximity of the root apices of healthy maxillary posterior teeth to the maxillary sinus floor (MSF) and mucosal thickening (MT) of the MSF using cone beam computed tomography (CBCT). Included were eighty-four CBCT pictures of patients with completely dentate maxillary posterior sextants that were in good health and ranged in age from 20 to 70 years. The maxillary posterior teeth's root apices and MSF were analysed anatomically in three different ways: Type 1 indicates no contact, Type 2 indicates at least one root apex in touch, and Type 3 indicates at least one root apex projecting into MSF. Additionally, the thickest area of the MSF was used to measure the MT. The patients were divided into two groups according to whether MT was present (2 mm) or absent (≤2 mm). Type 1, 2, and 3 proximity prevalence was determined to be 26 (15.5%), 61 (36.3%), and 81 (48.2%), in that order. Overall, MT (2<mm, mean: 8.6±7.5 mm) was shown by 62 (36.9%) maxillary sinuses. There was no statistically significant difference seen between the mean and prevalence values of MT (2<mm) according to proximity categories or gender.

- **Mahmood MA et. al. [80] (2023)** conducted research to investigate the anatomical relationship between the roots of erupted maxillary posterior teeth and maxillary sinus using CBCT (a retrospective study). A total of three hundred and forty-one CBCT pictures were inspected and analysed utilizing. With the use of software measurement tool, the distance was measured from the molar and premolar teeth, taking into account which tooth was closest to the sinus on both sides. The categorization employed in Jung's (2009) study was utilized to assess the connection between the maxillary sinus floor and the apices of the maxillary teeth. Type 0: The maxillary sinus floor is located above the maxillary posterior root tips. Type 1: The root apex touches the sinus floor. Type 2: The maxillary sinus floor is interposed between the roots. Type 3: Apical protrusion is observed over the maxillary sinus floor. The most common relation between the roots of the upper posterior teeth with the maxillary sinus was Type 2: the apices of the upper posterior teeth touching the sinus floor. The result showed no statistical difference between the age groups also, the relationship between sex and the relation of the teeth with the maxillary sinus was not significant.

3. F) comparison between panoramic and cone beam computed tomographic evaluation of relationship between maxillary molar teeth and maxillary sinus floor.

- **Fakhar HB et. al. [81] (2014)** conducted research to investigate the precision of panoramic radiographs in ascertaining the connection between the maxillary sinus floor and posterior root apices using Cone-Beam CT. 117 individual's paired panoramic radiographs and CBCT pictures were analyzed. First, second, and third molars were among the 452 posterior maxillary roots that were categorized using the connection with the maxillary sinus floor. In 56.7 percent of patients, there was agreement between the panoramic and CBCT results. Class 0 roots (no interactions with the sinus floor) demonstrated a high degree of agreement (89.5%) across the two imaging modalities. 50% of instances with root extension into the sinus cavity (class 3, 4) and 58.8% of roots in touch with the sinus floor (class 1) exhibited agreement. Panoramic imaging revealed protrusion in 36% of instances (class 0, 1, 2) while there was no protrusion into the sinus cavity. Premolar agreement was higher than molar agreement.

- **Lopes LJ et al. [82] (2016)** conducted study to assess signs on panoramic radiography that could predict root protrusion into the sinus. 46 people (330 maxillary posterior teeth) in all were enrolled in the CBCT and panoramic radiographic procedures. The posterior teeth's relationship to the maxillary sinus as well as the signs of protrusion of root apices into the

sinus that are associated with panoramic radiography were assessed. These signs included darkening in the root apices, projection of the root apices, interruption of the maxillary sinus floor, lamina dura, and a superiorly curving sinus floor enveloping the associated tooth root. According to CBCT scans, 109 teeth (33%) were clearly separated from the maxillary sinus floor, whereas 126 teeth (38%) had pierced into the maxillary sinus cavity. 236 (71.5%) of the patients generally had agreement with the placement in both imaging modalities.

- **Kirkham-Ali K et. al. [(83)] (2019)** conducted a comprehensive evaluation with the aim of examining research papers that evaluate the link between posterior maxillary tooth roots and the maxillary sinus by comparing the precision of panoramic imaging and cone-beam computed tomography (CBCT). MEDLINE, PubMed, Science Direct, Web of Science, Scopus, Cochrane, and EMBASE databases were searched electronically, with the results being imported into Endnote. According to analysis, a panoramic picture is adequate to determine whether the roots are clearly separated from the sinus. Panoramic photographs often misread the position of roots if they are laterally or medially protruding over the sinus and "just touching" it, giving the impression that the root is inside the sinus. When the root tip enters the sinus, the findings were not entirely consistent. While some studies found modest levels of agreement between the two modalities in this scenario, others reported significant levels of agreement. In these cases, it is highly recommended to schedule a CBCT in order to

accurately determine the risk of oral surgery with respect to maxillary posterior teeth.

- **Themkumkwun S. et. al. [84] (2019)** carried out research to determine the frequency of molar roots extending into the maxillary sinus, and the panoramic radiographic signals was compared with cone beam computed tomography (CBCT). There were sixty-five patients (20 men and 45 women) who had panoramic and CBCT pictures. Patients ranged in age from 13 to 82 years, with a mean of 35. All the patient included in study were Thai. There were 126 maxillary molar teeth in these individuals, consisting of 61 first molars, 55 second molars, and 10 third molars. Five third molars and seven second molars had conical-shaped roots. Each of these teeth's roots was assessed as a single root. On CBCT pictures, a total of 354 roots were examined. The most prevalent form (46%) was form 2, which is characterized by molar roots that extend beyond the sinus floor without a cortical bone in between. Type 0 (37.3%) and Type 1 (16.7%) were the next most frequent types. Regarding Type 2, which is characterized by roots extending into the maxillary sinus without a cortical bone of the sinus floor on CBCT images, the first molar's palatal root had the highest prevalence (9.3%), followed by the second molar's mesiobuccal root (8.2%).

- **Jung YH et. al. [85] (2020)** conducted research to assess the relationship between the maxillary sinus floor and the roots of maxillary posterior teeth. In addition, radiographic signs indicating actual root protrusion into

the maxillary sinus were evaluated on panoramic radiographs. Paired panoramic radiographs and CBCT images from 305 subjects were analyzed. This analysis classified 2,440 maxillary premolars and molars according to their relationship with the maxillary sinus floor on panoramic radiographs and CBCT images. In addition, interruption of the sinus floor was examined on panoramic radiographs. The inclusion criteria were patients aged from 20 to 50 years with the presence of all maxillary premolars and molars. Patients with pathologic lesions in the maxilla and with a history of orthodontic treatment were excluded from the study. The final sample group included data from 305 patients (162 men and 143 women; mean age, 28.6±7.3 years; age range, 20 to 50 years). A total of 2,440 teeth were selected for the study, including 1,220 molars and 1,220 premolars. The relationship between the maxillary posterior teeth and the maxillary sinus floor was evaluated according to the criteria established by Jung and Cho. On the panoramic radiographs, the relationship of the root to the maxillary sinus floor was classified into three types: type 0, the root was not in contact with the maxillary sinus floor; type 1, the root was in contact with the cortical border of the sinus; and type 3, the root apex projected into the sinus cavity. The majority of molars had a type 3 root-sinus relationship on the panoramic radiographs. First premolars exhibited type 0 more frequently than second premolars, with type 1 more frequently observed in the latter. Four categories were identified from the root-sinus relationships shown in the CBCT images. In all first molar roots, the prevalence of type 3 (30.9%) was similar to that of type 2 (30.3%). All the maxillary first molars were 3-rooted. In the first molars, type 2 was most

frequent in the palatal roots (43.1%) and type 3 was most frequent in the mesiobuccal roots (32.8%). Panoramic radiographs were used to assess sinus floor interruption as a sign of root protrusion into the sinus floor. Panoramic radiographs of the majority of instances of root protrusion into the sinus on CBCT imaging revealed discontinuities in the maxillary sinus floor. On the panoramic radiographs, the sinus floor was not interrupted in the majority of type 2 categorization cases.

- **Costa TD et. al. [(86)] (2023)** conducted study to assess the radiographic indicators of the proximity between the maxillary sinus and the maxillary molar roots in panoramic radiographs using CBCT as a control. The maxillary molar and premolar regions of 81 individuals with panoramic radiographs and CBCT were examined. Conditions deemed pathological were not included in this research. An expert dental radiology examiner randomly and independently assessed the panoramic radiographs and the CBCT. A total of 1,055 root apices were assessed separately. The examiner used a scale of 0 to 3 to rate the images from both panoramic radiography and CBCT in order to determine the relationship between the maxillary molar and premolar apices as well as the maxillary sinus. The possible ratings were: 0-Without relationship or distant; 1-Root apex projection or overlapping; 2-Maxillary sinus circumventing the tooth root; and 3-Interruption of the continuity of maxillary sinus floor. When comparing the categorization in CBCT and panoramic radiographs, type 1 had the greatest prevalence ratio (52,7%). On CBCT, there was no distinction between the type 1 signal and the gold standard. This study

concluded that the proximity between the maxillary sinus and the roots of premolars and molars may be assessed using panoramic radiography. In situations when the maxillary sinus and apices overlap, CBCT is still the recommended investigation for a more thorough assessment.

4. MATERIALS AND METHOD

Study design

In this retrospective study, 300 CBCT images of maxillary sinus floor (MSF) and maxillary 1st molar (150 coronal section and 150 sagittal section) were randomly selected irrespective of gender of the patients from an oral and maxillofacial radiology centre, Lucknow, UP. All CBCT scans were taken via Cone beam computed tomography (Acteon X-mind trium) Software- Anatomage, FOV-11x9 cm Grayscale- 32-bit, Voxel – 0.25 mm, Acquisition time- 7.9 sec, 90-120 KVP, 5mA (Image 1, 2, 3, 4). Consent from the radiology centre was granted by the concerned authority.

Figure 6: CBCT macine

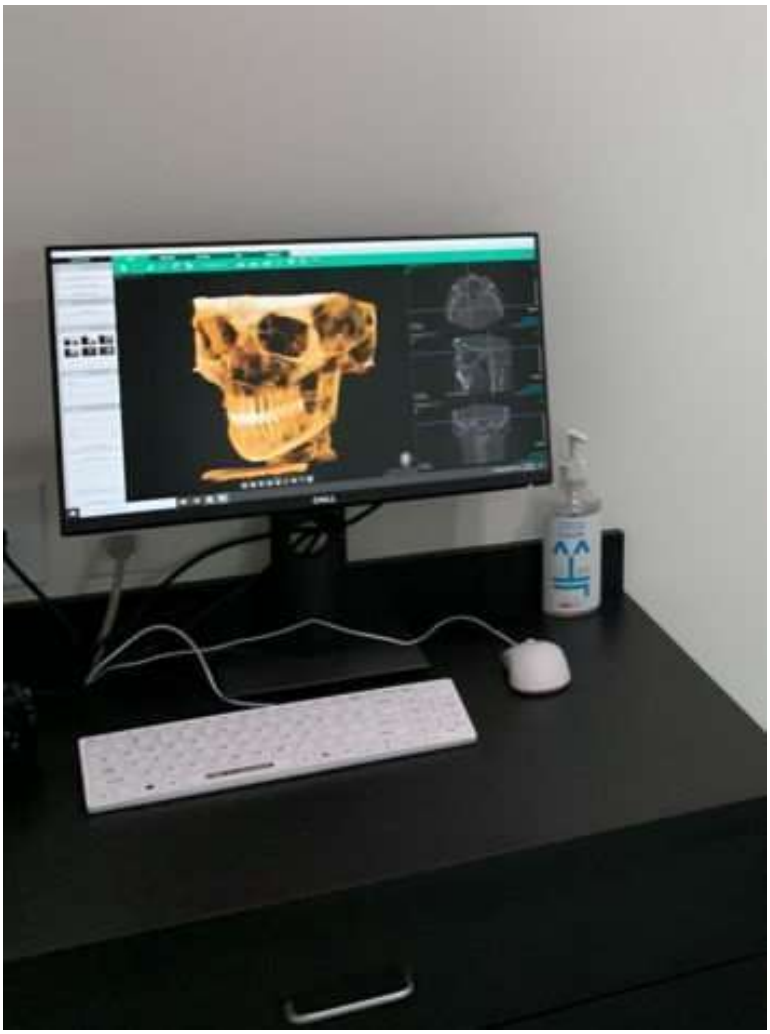


Figure 7: computer screen showing CBCT image

Study sample

300 CBCT images were taken from CBCT center including 150 coronal section and 150 sagittal sections. The study samples were randomly selected (82 males and 68 females). 78 images from 1st quadrant (right maxillary 1st molar consisting of 40 images from males and 38 images from females) and 72 images (left maxillary 1st molar consisting of 42 images from males and 30 from females) were taken.

All the male and female samples were categorised in four age groups (20-30 years, 31-40 years, 41-50 years, 51-60 years) and the data collected from the 300 CBCT images were analysed and sent for statistical analysis.

Inclusion criteria

1. Patients without any maxillary sinus and maxillary alveolar bone diseases
2. Fully erupted teeth and fully formed apexes
3. Maxillary molar with neither definitive root resorption nor bony destruction around the teeth.
4. Maxillary first molar teeth without any periapical pathology and without periodontal pocket.

Exclusion criteria

1. Patients with developmental anomalies in the maxillary sinus
2. Patients with maxillary sinus polyp
3. Patients with maxillary sinusitis
4. Patients having prosthetic restoration
5. Patients having root canal treatment
6. Patients having TMJ disorders
7. Patients who are under any orthodontic treatment procedure.

Methodology

1. In the present study all the subjects fulfilling the criteria were randomly selected. Consent for using the image data was from the concerned authority of the CBCT diagnostic center.
2. All the subjects were categorized on the basis of age, gender and right or left side of the maxilla.
3. All the images were selected on the basis of inclusion and exclusion criteria.
4. Vertical distance is measured by using measuring tool available in the CBCT machine by connecting the tip of palatal root of maxillary first molar and the inferior most border of the floor of maxillary sinus presents just above the palatal root tip.
5. The vertical distance is measured for both right and left maxilla in both coronal section and sagittal section.
6. All the data collected was tabulated and subjected to statistical analysis.

Data analysis

All the images were categorized according to gender and different age groups. The samples were categorized in to four age group 20-30, 31-40, 41-50, 51-60.

The observed vertical distance is correlated with age of the individuals, gender of the individual and sides of the maxilla using Pearson correlation coefficient.

Pearson correlation coefficient between two variable is defined as the covariance of the two variables divided by the product of their standard deviation.

Image 1: CBCT images of left maxillary first molar teeth in male patient - coronal section

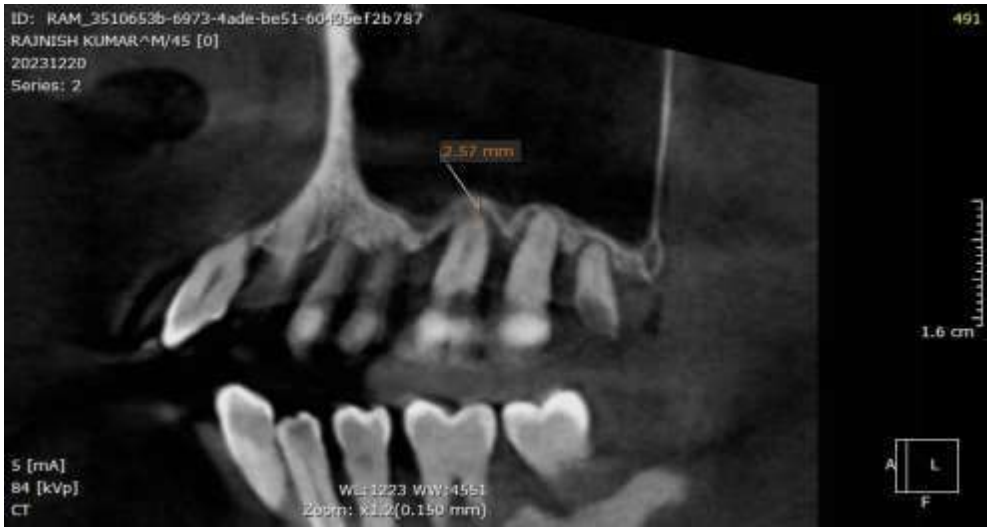


Image 2: CBCT image of left maxillary first molar teeth in male patient- sagittal section

Image 3: CBCT images of right maxillary first molar teeth in female patient- coronal section

Image 4: CBCT image of right maxillary first molar teeth in female patient- sagittal section

5. OBSERVATIONS AND RESULT

In the present study total number of participants were 150 which was selected randomly, out of which 82 (55%) were males while 68 (45%) participants were female (as shown in Table 1, Figure 1). All the samples were categorized in to four age groups 20-30, 31-40, 41-50, 51-60. In the first sample group, which consists of individuals of age 20-30, there are 25 males and 23 females which is 30.49% and 33.82 % respectively. In the second sample group of age 31-40, there was 25 males and 19 females which is 30.49% and 27.94 % respectively. In the third age group consisting of age 41-50, there is 17 males and 14 females which is 20.73% and 20.59% respectively, while in the sample group of age 51-60 there are 15 males and 12 females which is 18.29 % and 17.65 % respectively. (Table 2, Figure 2). The images from first quadrant as well as from second quadrant of maxillary arch were taken. The details of the data are presented in Table 1, 2 and 3.

Table 1: Gender wise distribution of participants

GENDER	NO. OF PARTICIPANTS (N)	PERCENTAGE
Male	82	55%
Female	68	45%

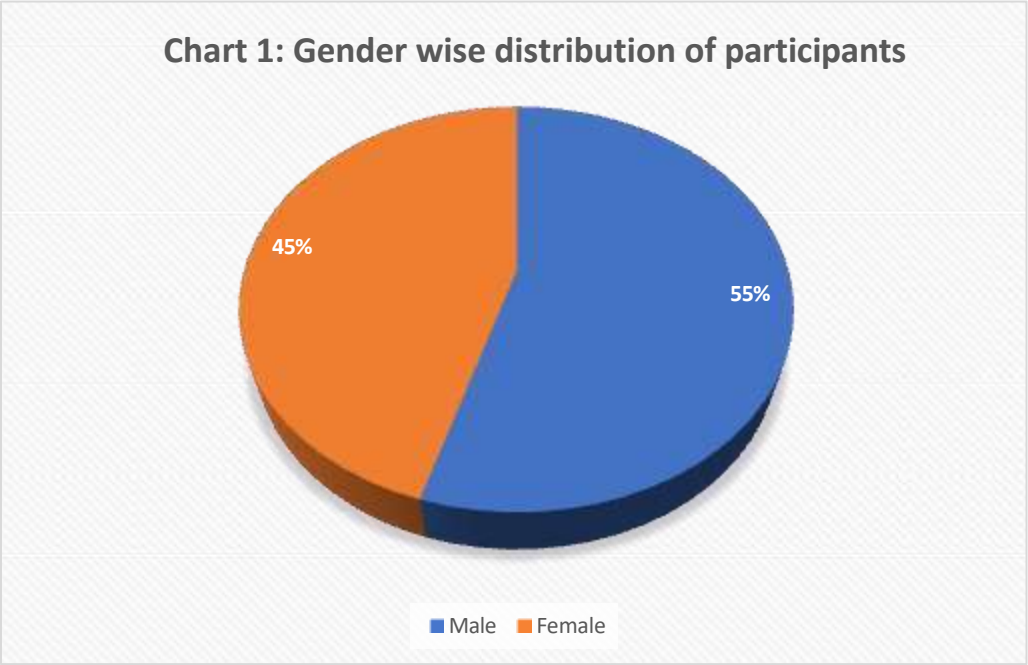
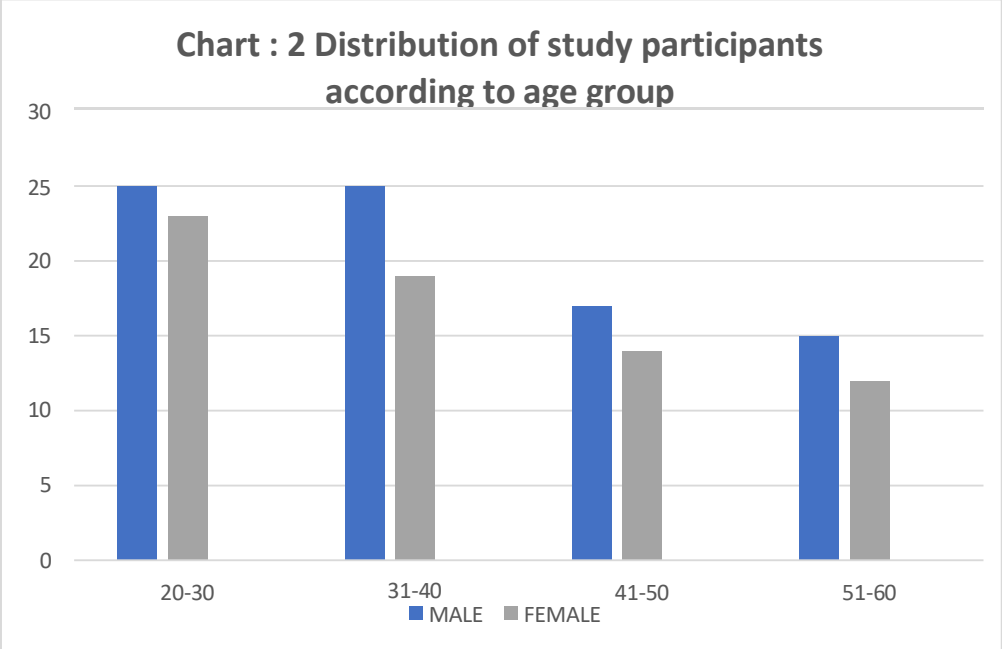


Table 2: Distribution of study participants according to age group

AGE GROUP	MALE N (%)	FEMALE N (%)
20-30	25 (30.49 %)	23 (33.82 %)
31-40	25 (30.49 %)	19 (27.94 %)
41-50	17 (20.73 %)	14 (20.59 %)
+51-60	15 (18.29 %)	12 (17.65 %)



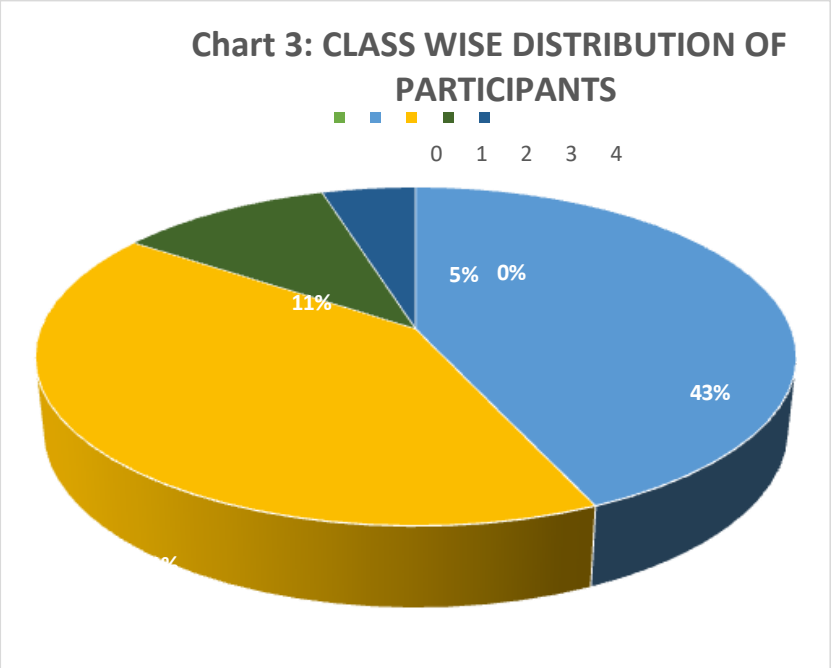
According to the classification given by **Didlescu A. et al.** [31] the images are categorized based on the measured vertical distance between the maxillary sinus floor and the palatal root tip of the first molar in the maxilla. Class 0 pertains to a situation where the vertical distance (d) between the sinus floor and the palatal root tip of the maxillary first molar teeth is equal to 0 mm. Class 1 is a situation where the vertical distance between the sinus floor and the palatal root tip of the maxillary first molar teeth is 0 mm < d < 2 mm. Class 2 is a situation where the vertical distance between the maxillary sinus floor and the palatal root tip of the maxillary first molar teeth is 2 mm ≤ d < 4 mm. Class 3 is a situation where the vertical distance between the maxillary sinus floor and the palatal root tip of the maxillary first molar is 4 mm ≤ d < 6 mm. Finally, class 4 is a situation where the vertical distance between the maxillary sinus floor and the palatal root tip is 6mm < d.

The current study's results show that the relationship between the maxillary sinus floor and the palatal root tip of the maxillary first molar root occurs in

class 0 at 0% (0), 43.33 % in class 1 (65), 41.33 % in class 2 (62) and 10.67 % (16) and 4.67 % (7) in class 3 and class 4, respectively. The results of this study reveal that, the majority of the time, the vertical distance between the maxillary sinus floor and first molar teeth is between 0 and 2 mm, or class 1. The second most common vertical distance observed is between 2-4 mm, or class 2, and class 0 (0 mm) is the least common root-floor relationship, as indicated by Table 3 and Chart 3,

Table 3: Class-wise distribution of study participants

CLASS	NUMBER	PERCENTAGE
0	0	0 %
1	65	43.33 %
2	62	41.33 %
3	16	10.67 %
4	7	4.67 %

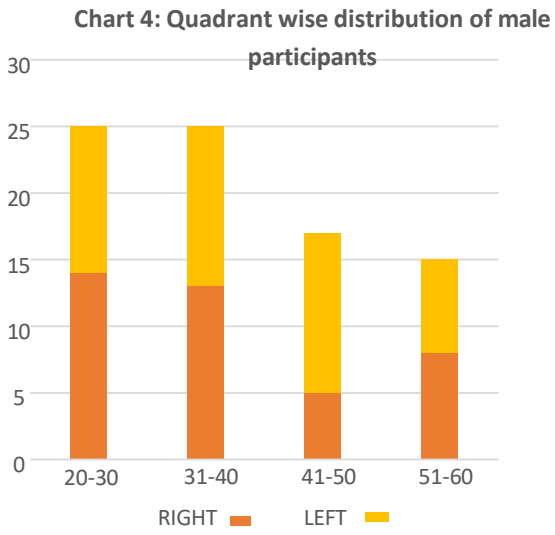


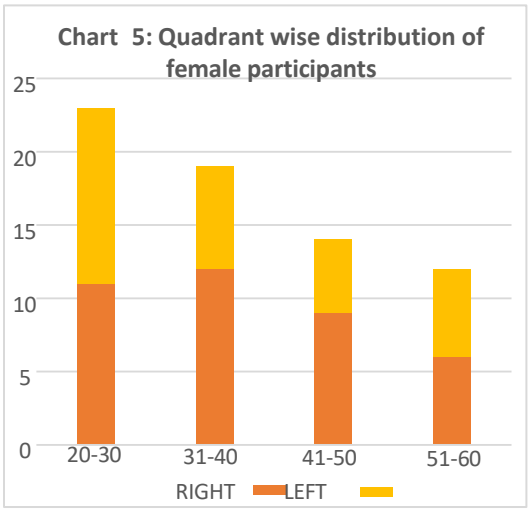
Further categorization of sample groups on the basis of gender and right and left side of maxillary molar teeth reveals that for male participants the first sample of groups (20-30 years) consists of 14 right maxillary first molar teeth and 11 left maxillary first molar teeth. The second age group (31-40 years) consists of 13 right maxillary first molar and 12 left maxillary first molar teeth. The third age group (41-50 years) consists of 5 right maxillary first molar teeth and 12 left maxillary first molar teeth, while the fourth age group (51-60 years) consists of 8 right maxillary first molar and 7 left maxillary first molar. (As shown in Table 4 and Figure 4).

The female participants of first sample age group (20-30 years) consists of 11 right maxillary first molar and 12 left maxillary molar and the second sample age group (31-40 years) consists of 12 right maxillary first molar and 7 left maxillary first molar teeth and in the third age group (41-50 years) consists of 9 right maxillary first molar and 5 left maxillary first molar teeth, while the fourth age group (51-60) consists of 6 maxillary first molar both right and left quadrants.(Table 4 and Figure 5).

Table 4: Quadrant wise distribution of participants

		MALE	
	AGE GROUP	**RIGHT**	**LEFT**
	20-30	14	11
	31-40	13	12
	41-50	5	12
	51-60	8	7
TOTAL	**82**	**40**	**42**
		FEMALE	
	AGE GROUP	**RIGHT**	**LEFT**
	20-30	11	12
	31-40	12	7
	41-50	9	5
	51-60	6	6
TOTAL	**68**	**38**	**30**





In the present study, CBCT image data was collected from 150 coronal section and 150 sagittal sections. The youngest participant was of 20 years while the oldest was of 60 years. the mean age of the study participants was 37.55 +/- 11.59 as shown in table 5.

The study reveals that closest root tip of maxillary first molar was found to be 0.22 mm in a 42-year-old female participant while maximum distance observed between sinus floor and root tip is 9.25 mm in 38-year-old male participant in coronal section which shows that the mean vertical dimension in the coronal section was 2.45 +/- 1.57, while in sagittal section the closest vertical distance is found to be -3 mm inside the maxillary sinus floor in a 27 year old female participant and the maximum vertical distance measured is 8.80 mm in a 38 year old male participant which shows that the mean vertical distance in the sagittal section is 2.35 +/- 1.65 as presented in Table 5.

Table 5: Descriptive statistical data of the participants

	N	Minimum	Maximum	Mean	Std. Deviation
VD in sagittal section	150	-3.0	8.80	2.3529	1.64986
VD in coronal section	150	0.22	9.25	2.4521	1.57378
AGE	150	20.00	60.00	37.5533	11.59642

It is also found that palatal root tip of three maxillary first molar teeth were showing perforation in maxillary sinus floor by -1.5 mm, -2.2 mm and -3 mm. Interestingly these were less commonly found root floor relationship but all these measurements were observed in coronal section of female participants, however no significant data is obtained from the current study, hence the data obtained is found to be statistically insignificant.

Following evaluation of the vertical distance between the four distinct age groups, the mean root value in the sagittal section is found to be 2.0+/-1.19 for the first sample group (20–30 years), 2.47 +/– 1.69 for the second age group (31–40 years), 2.71 +/– 1.76 for the third age group (41–50 years), and 2.87 +/– 1.63 for the fourth age group (51–60 years). This demonstrates that the vertical distance between an individual's maxillary first tooth and sinus floor increases with increase in age as presented in Table 6.

Similar to this, in the coronal section, the mean root floor distance is found to be 1.78+/-1.51 in the first sample group (20-30 year), 2.38+/-1.75 in the second sample group (31-40 year), 2.78+/-1.53 in the third sample group (41-50 year), and 2.89+/-1.62 in the fourth sample group (51-60 year). The results

obtained further demonstrate that the distance between the maxillary sinus floor and the first maxillary molar increases with age, as shown in Table 6.

Table 6: The mean values of root-floor distances related to age groups

	20-30 years Mean (SD)	**31-40 years Mean (SD)**	**41-50 years Mean (SD)**	**51-60 years Mean (SD)**
VD in sagittal section	2.0 (1.19)	2.47 (1.69)	2.71 (1.76)	2.87 (1.63)
VD in coronal section	1.78 (1.51)	2.38 (1.75)	2.78 (1.53)	2.89 (1.62)

Correlation of mean age with vertical dimension

This study reveals that as the mean age of the participants increases, there is increase in the vertical dimension in different age groups of both males and females. The Pearson Correlation value for VD in sagittal section was 0.226 and for VD in coronal section was 0.224 as shown in table 5. There is a positive correlation between the mean age and vertical dimension in both sagittal and coronal section both between males and females, The value of p indicates the results to be statistically significant as shown in Table 7

Table 7: Correlation of mean age with vertical dimension

		VD in sagittal section	VD in coronal section
Age	Pearson Correlation	0.226	0.224
	Sig. (2-tailed)	0.005	0.006

p value ≤ 0.05 is considered significant, statistically significant results obtained.

Correlation of gender with vertical dimension

In the current study there is no association observed between the patient of different age groups and the vertical distance between the maxillary sinus floor and palatal root tip of maxillary first molar teeth. This shows negative correlation between gender and vertical dimension in both sagittal and coronal section and the study results suggest that gender is not associated with the change in the vertical dimension between the floor of maxillary sinus and palatal root of maxillary first molar. The Pearson Correlation value for VD in sagittal section was 0.049 and for VD in coronal section was 0.089 as shown in Table 8.

Table 8: Correlation of gender with vertical dimension

		VD in sagittal section	VD in coronal section
Gender	Pearson Correlation	0.049	0.089
	Sig. (2-tailed)	0.552	0.281

p value $\leq$ 0.05 is considered significant, statistically insignificant results obtained.

Correlation of right or left side of the tooth with vertical dimension

In the present study while evaluating the CBCT image data it was found that there is no difference in the vertical distance between the maxillary sinus floor and palatal root tip of the maxillary first molar right and left side of the

maxilla. The Pearson Correlation value for VD in sagittal section was 0.100 and for VD in coronal section was 0.090 which shows a negative correlation between quadrant and vertical dimension in both sagittal and coronal section shown I Table 9. The study results suggest that change in the vertical dimension between the floor of maxillary sinus and the palatal root of maxillary first molar is not associated with the quadrant that is recorded.

Table 9: Correlation of right or left side of maxilla with vertical dimension

		VD in sagittal section	VD in coronal section
Quadrant wise	Pearson Correlation	0.100	0.090
	Sig. (2-tailed)	0.223	0.273

P value ≤ 0.05 is considered significant, statistically insignificant results obtained.

6. DISCUSSION

Understanding the fundamentals of CBCT imaging is crucial for both patients and referring practitioners, as it is a commonly utilized modality in dentistry and maxillofacial imaging. The idea of CBCT was initially presented in radiology not long after the first CT scanner was developed. Before gradually introducing it for other uses, angiography was its primary use. The second part of the 1990s witnessed the beginning of the development of specialist CBCT scanners for use in dentistry. Shortly after, CBCT applications in the fields of dentistry, maxillofacial, and ear, nose, and throat began to take off. Nowadays, CBCT is a commonly utilized technology in several dental specialties, including orthodontics, endodontics, maxillofacial surgery, and implant design. Due to its extensive use, there are now a number of issues with CBCT exposure optimization and justification, CBCT user training, and CBCT scanner quality assurance.

The present research consists of CBCT images of maxillary sinus floor and maxillary first molar teeth in both coronal and sagittal section of 150 participants. The sample consist of 82 male participants and 68 female participants. The whole sample group is categorized into four age groups. First sample of age group is 20–30 year, second age group is 31–40 year, third age group is 41- 50 year while the fourth age group is 51-60 year. In the current study the first age group consists of 25 males and 23 females which is 30.49% and 33.82 % respectively and in second age group there was 25 males and 19 females which is 30.49% and 27.94 % respectively and in the third age group there is 17 males and 14 females which is 20.73% and 20.59% respectively

while the fourth age group consist of there are 15 males and 12 females which is 18.29 % and 17.65 % respectively.

In the present research the root floor relationship was categorized into five classes based on classification given by **Didlescu A et.al.** [(31)] Class 0 where the root tip just touches the sinus floor i.e. vertical distance is 0 mm, class 1 is where the vertical relationship is between 0-2 mm, class 2 where the vertical distance is between 2-4 mm, class 3 where the vertical distance is 4-6 mm and class 4 where the vertical distance is beyond 6 mm. In the current research out of 150 scans, 65 were found to be in class 1 relationship, 62 were found to be class 2 relationship, 16 were found to be in class 3 relationship and 7 were found to be in class 4 relationship.

The similar study was done by **Georgiev T et. al.** [(39)] where it was revealed that out of 258 first molar tooth 173 teeth were found to be in hazardous proximity where the vertical distance is less than 2 mm and 50 teeth were found to perforating maxillary sinus floor up to 2 mm while 1 tooth was perforating the sinus up to 4mm. **Kwak HH et. al.** [(29)] performed a study on twenty-four sides of hemi-sectioned Korean skull's maxilla and concluded that in the first premolar region, the distance was greatest, and in the second molar area, it was the smallest from the root apex to the inferior sinus wall. **Nino-Barrera J.et. al.** [(43)] also performed a study to assess the relationship between the maxillary sinus floor and upper posterior root tip in Colombian population using CBCT which demonstrated that 12.5 % maxillary first molar root tips were found to be inside the maxillary sinus while the least frequently found tooth was first premolar tooth (0%). In research performed by **Shokri A et. al.**

[15], the majority of the teeth did not come into contact with the sinus floor, however the more posterior the maxillary teeth, the greater was the likelihood that a root may protrude into the maxillary sinus. **Asthana G et. al.** [36] performed a study to assess the relationship between the maxillary sinus floor and the maxillary molar root tips using CBCT and concluded that the distance between sinus floor and root tip was longest for the first molar mesiobuccal root and shortest for the second molar distobuccal root. 9.4% of all root apices were closely related to the maxillary sinus floor by close contact or by protrusion into the sinus. In the first molars, palatal roots were always located closer to the sinus than buccal roots.

Tian X. M. et al. [40] performed a study on CBCT images of 848 patients to assess the position of the posterior root relative to the sinus floor and quantify the distances between posterior root apex and the adjacent border of the sinus floor and concluded that the first premolar was always farther (-6.0 to 23.2 mm) and the second molar mesio-buccal root was closest (-7.0 to 15.5mm) to the border of the maxillary sinus floor. The root protruding into the sinus was rare in the first premolar and dominated in the first molar palatal root (-1.3 to 17.8 mm). In study performed by **Estrela C et. al.** [41] it came across that the roots of maxillary molars were closer to the MS than those of premolars, and that only premolars had a similar thickness of cortical bone in the area closest to the apex and furcation area on the MS floor.

Fry RR et. al. [42] conducted a study by assessing the Denta scans of 50 individuals with bilaterally erupted maxillary first premolars to maxillary second molars in a normal eruption. The study came to the conclusion that the

buccal root of the maxillary molars projecting into the maxillary sinus was

more common. The maxillary posterior tooth roots that were closest to the maxillary sinus floor were found to be the palatal root of the second premolar and the mesiobuccal root of the first molar. The maxillary first premolar and maxillary first molar has much less bone thickness on the buccal aspect of the root than other maxillary posterior tooth roots. **Maxood M. et. al.** [(45)] conducted research to determine the distance between the roots of the maxillary posterior teeth and the sinus floor, as well as the thickness of the bone separating the roots from the alveolar cortical bone, by utilizing a Denta scan and revealed that it was more typical for the buccal root of the maxillary molars to project into the maxillary sinus than maxillary premolar. The mesiobuccal root of the first molar and palatal root of the second premolar was identified to be among the roots of the maxillary posterior teeth that were closest to the maxillary sinus floor.

Katti G et. al. [(47)] conducted a study by taking 50 patients as sample ranging between age 10 to 72 with equal no of male and female participants. The study concluded that the majority of roots were not in contact with the maxillary sinus, a significant number were either in contact with it or were penetrating into it. Palatal root of 5 maxillary first molars were found to be perforating the maxillary sinus floor also found that the mean distance from the sinus floor for the furcation was less than 5 mm (3.64% ± 1.14) and the rest was greater than 5 mm (6.19% ± 2.63). **Tafakhori Z et. al.** [(49)] in 2018 performed a study evaluating 35 CBCT radiographs of participants of more than 20 years of age and stated that class 1 root -floor relationship was most common in left of maxillary first molar. The prevalence for class 1 was 50% and for class 2 and 3 were 37.5 % and 43.8 % respectively. While type 0 root- floor relationship is

most common for right maxillary first molar teeth. **Makris LM et. al.** [50] in the same year 2018 performed research on 226 maxillary sinuses and concluded that the maxillary first molar was the tooth closest to the maxillary cortical bone, whereas the mesiobuccal root of the maxillary second molar was the root closest to the maxillary sinus floor. **Gu Y et. al.** [51] performed a similar study to evaluate influence of adjacent teeth loss on the distance between the maxillary sinus floor and root tips of maxillary molars. The root floor relationship is categorized in to three, type OS: where the root apex extends below or outside the MSF, type CO: where the root apex contacts the MSF and type IS where the root apex extends above or within the MSF. Of all posterior root apices, type OS was the most prevalent root-floor relationship which means that root tips of all the posterior molar are either just below or outside the maxillary sinus floor. While the mesiobuccal root (MBRs) of the maxillary second molars (MSMs) and the palatal root (PRs) of the maxillary first molars (MFMs) had the greatest Type IS percentages; (condition where root is either above or inside the maxillary sinus), at 21.6% and 24.8%, respectively. The mean distance between palatal root tip to the maxillary first molar teeth is 1.4+/- 3.4 mm.

While analyzing the data it is revealed that in all the above studies as the age of the individual increases the vertical distance between maxillary sinus floor and palatal root tip of maxillary first molar increases. Similarly in our study as well similar findings were observed. The Pearson Correlation value for VD in sagittal section was 0.226 and for VD in coronal section was 0.224. The current study reveals that 7 percent of the total 150 individuals have class 5 root-molar relationship and interestingly all the individuals were of more than 35 years of age with two cases of exception where individual of 20 years age

had class 5 root-molar relationship. This may be explained by the fact that themaxillary sinus's air pressure, growth hormones, and pneumatization, history of any sinus surgery are only a few of the numerous variables that affect its size. The results of the current study indicates that as the age increases the vertical distance increases, this co-relation is found to be significant both in male as well in female patient.

Tang L et. al. [55] used cone-beam computed tomography (CBCT) scans to analyse the relationship and distance between the maxillary sinus floor (MSF) and the root apex of the maxillary posterior teeth, as well as whether they changed with age. In accordance to the current study the findings showed that, compared to the older age groups, the mean distance under 40 years old from the root apex to the maxillary sinus floor was significantly shorter ($P < 0.05$). For people over 40, there was no appreciable difference in the equivalent mean distance. This is also supported by study performed by **Al-Saedi A et. al.** [68] The study also revealed that with increase in age size of maxillary sinus decreases which causes increase in vertical distance between maxillary sinus and maxillary posterior teeth. Most authors who studied the maxillary sinus concluded that it begins its development from birth until the maximum peak of growth, from which it begins to decrease in volume with age.

However, in a study performed by **Anter E et. al.** [56] the first molars in all mesio-buccal "MB", disto-buccal "DB", and palatal "P" roots of the teeth under examination had the highest prevalence of class 0 in the three roots. It also shows that, in terms of vertical relationship classes, the roots of the first maxillary molars had a significant inverse relationship with age, which is inconsistent with the findings of the current study. Similarly, the results of the

current investigation are inconsistent with a related study by **Shrestha B et al.** [(69)], which found no statistically significant age differences between the groups, while research performed by **Ahn NL et. al.** [(12)] concluded that male, older age, hyperdivergent skeletal pattern, and large gonial angle groups had significantly closer distances between maxillary root tips and the sinus floor or more protrusion of the roots into the sinus and it also shows that males are more likely than females to have tooth roots protruded into the maxillary sinus. **Tian X. M. et al.** [(40)] performed a study that revealed that the mean distances of all roots of maxillary premolars and molars to the adjacent border of the sinus floor increased with increasing age. The root was closer to the border of the maxillary sinus floor before the age of 20 and farther after the age of 60.

The current study reveals that gender does not influence the vertical distance between the maxillary sinus floor and palatal root of maxillary first molar tooth as the data obtained shows a negative Pearson correlation between gender and vertical distance which is 0.226 in sagittal section and 0.224 in coronal section. The result of the current study is supported by studies performed by **Kilic C et. al.** [(52)], **Tafakhori Z et. al.** [(49)], **Didlescu A. et al.** [(31)], and **Tang L et. al.** [(55)] where the results shows that gender has no effects on

the mean distance from the root apex to the maxillary sinus floor. Recent research performed in 2020 by **Hameed K.S. et al.** [(57)] and **Pei J. et al.** [(58)] also shows no significant correlation when compared to the male and female groups. While results of the studies performed by **Shokri A et. al.** [(33)] and **Ok E et. al.** [(34)] **Ahn NL et. al.** [(44)] is not consistent with the present study where it was revealed that males have significantly more roots protrusion in to the

maxillary sinus floor indicating that the vertical distance between males is lesser than that in females. Interestingly **Kaushik M. et. al.** [(63)] performed research and came across that males were observed to have a greater distance than females between the posterior root apices and the neighboring border of the MSF.

In most of the studies it is seen that there is insignificant difference between vertical distance between maxillary sinus floor and palatal root tips of maxillary sinus floor of left or right side of maxilla. The present study also reveals that there is no significant difference found between the vertical distance found between right and left side of the maxilla which goes with the result of study performed by **Ok E et. Al.** [(34)]**.** This study was performed by evaluating 2486 maxillary molar via using CBCT images and concluded that there is no significant difference between right and left side of the maxilla. **Kilic C et. al.** [(52)] also performed similar study to assess the relationship between maxillary sinus floor and maxillary posterior root tips using CBCT machine.87 right and 89 left maxillary sinus were included in this study. This study also came across that there is no appreciable difference between vertical distance between right and left side of maxilla. The study performed by

Kumar P et. al. [(54)] also suggests that there is no discernible difference found between vertical distance between posterior root tips and floor of maxillary sinus right and left side of maxilla. **Tang L et. al.** [(55)] in 2020 also proved similar results that there is no variation seen in the vertical distance observed between maxillary sinus floor and root tips of posterior maxillary premolars and molars in right and left side of the maxilla. Total 221 patients were

included in this study. Similarly, **Junqueira RB et. al.** [60] also in year 2020 came across with the result that there is no difference found between the vertical distance in right and left side of the maxilla. This is supported by study performed by **Motiwala M. et. al.** [66] in which total 1066 subjects were studied to evaluate the co relation between age, gender and bilateral jaw symmetry in relation to the roots of the maxillary posterior teeth and the maxillary sinus floor in vertical dimension. This study also concluded that there is no significant difference found between vertical distance of right and left side of maxilla. **Mahmood MA et. al.** [80] also conducted a similar study in 2023 with which supports the result of the current study. The aim of the study was to investigate the anatomical relationship between the roots of erupted maxillary posterior teeth and maxillary sinus using CBCT in Sulaimani city (a retrospective study) with total of three hundred and forty-one CBCT pictures.

Inference

- The present study reveals that most common relationship found is class 1 root-molar relationship i.e. 0-2 mm vertical distance between the palatal root tip and floor of maxillary sinus, while class 2 root -floor molar relationship where the vertical distance is 2-4 mm is the second most common. (Acc. to classification given by **Didlescu A et. al.)**
- The present study reveals that as the age of the individual increases the vertical distance between palatal root tip of maxillary first molar and maxillary sinus floor also increases because of the fact that with increasing age maxillary sinus tends to shrink in size.
- The current study reveals that gender does not have any influence on the vertical distance between the root tip of maxillary first molar teeth and floor of

maxillary sinus.

- The current study also reveals that side of maxilla does not have any influence on vertical distance.

7. CONCLUSION AND SUMMARY

Cone beam computed tomography was helpful in this investigation in determining the vertical connection between the maxillary sinus floor and the palatal root tip of the maxillary first molar and their variation pertaining to age and gender. The palatal root, which is the longest of the three, is the most important indicator of the root floor relationship. Nevertheless, all three of the roots of the maxillary first molar tooth are thought to be closely related to the maxillary sinus floor. This study reveals that most of the palatal root tip of maxillary tooth were in class 1 relationship with maxillary sinus floor which means that vertical distance between root tip and sinus floor is between 0- 2 mm while second most common root-floor relationship is between 2-4 mm which falls under class 2 root -floor relationship. The least common root molar relationship was found to be class 0. (0 mm vertical distance). This present study reveals that as the age increases there is increase in vertical distance between maxillary sinus floor and maxillary first molar tooth both in male and female participants. This is due to the fact that the maxillary sinus develops from birth until it reaches its maximal growth peak, at which point its volume starts to decline. with age. While there no significant difference found between the vertical distance in right and left side of the maxilla. Although all the sinus floor perforation was found in female participants but the results obtained is statistically insignificant. Hence it can be interpreted that gender and right and left side of the maxilla does not influence the vertical distance between maxillary sinus floor and palatal root tip of maxillary first molar tooth. For the purpose of preoperative treatment planning and complication avoidance, it is

helpful to know where the root apex is in relation to the surrounding anatomic structures.

Comprehending the anatomical relationship between the maxillary sinus and the molar teeth aids in the proper planning of preoperative care and helps prevent complications during minor oral surgical procedures such as extractions or surgical removals involving the maxillary posterior teeth, which are situated in close proximity to the maxillary sinus. The present study will help us to know the projection and protrusion lengths of the teeth root superior to the maxillary sinus floor as well as the changes in their vertical distance based on the age and gender of the individual which will be beneficial for better prognosis and treatment plan. Advanced technologies such as Cone Beam Computed Tomography (CBCT) provides a medium-to-large field-of-view volume that encompasses the craniofacial area, enabling visualization of the maxillary sinuses prior to treatments that are performed in close proximity to the sinus floor, such as implant placement, sinus floor elevation, and tooth extraction, the maxillary sinus must be seen and assessed. Pretreatment evaluation can be facilitated by the correlation shown in this study, which might help anticipate treatment results while minimising the possibility of challenges and complications.

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ANNEXURE 1

DISSERTATION PROFORMA

Assessment of the relationship of palatal root tip of maxillary first molar with maxillary sinus floor in both coronal and sagittal section using computed tomography volumetric imaging (CBVI): A retrospective study

DEPARTMENT OF ORAL MEDICINE & RADIOLOGY

Babu Banarasi Das College of Dental Science, Lucknow

Radiographic investigation (CONE BEAM COMPUTED TOMOGRAPHY):

Vertical distance (VD) between maxillary sinus and palatal root tip of maxillary first molar:

Coronal section	Sagittal section
Right:	Right:
Left:	Left:

STUDENT SIGNATURE **GUIDE SIGNATURE**

ANNEXURE 2A

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Guidelines for Devising a Participant / Legally Acceptable Representative Information Document (PID) in English

Guideline for preparation of the participant information document	
While submitting your project report to the Institutional Ethics Committee, ensure that you have included participant information document and an informed consent form that is prepared as per the guidelines for Good Clinical Practice-Centre for Drug Candidate Optimization (GCP-CDCO2001), International Conference on Hormonization-Good Clinical Practice (ICH – GCP), ICMR ethical guidelines 2006, and the Declaration of Helsinki. The document is important because it enables the participants to make an informed choice. It also has got to be unique because no two research projects are identical. **The participant information document (PID should include only those headings listed below which are relevant to that study. Any further information you wish to add, is your choice.**	
1.	Participant information document and an consent form **in English and Hindi** (other languages if required)
2.	Font: Arial spacing of lines with 1.5
3.	Size: 12
4	All the consent forms must have Version No, Date, Page no **in the footer**
5.	In the case of participants with age≥ 18 yrs, PID and consent form should be attached while in the case of participant's age≤ 18 yrs and ≥ 8 yrs the above along with information document and assent form for children (minor) should be attached. In the case of ≤ 8 it will be signed by the guardian.

Potential recruits to your research/trial study must be given sufficient information to allow them to decide whether or not they want to take part. The Information Document should contain information under the headings given below, and preferably in the order specified. It should be written in simple, non-technical terms and be easily understood by a lay person. Use short words, sentences and paragraphs.

1. **Study Title**
   Is the title self-explanatory to a lay person? If not, an additional simplified title may also be included.

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2. **Invitation Paragraph**

You should explain that the patient is being asked to take part in a research/trial study.

States:

–You are being invited to take part in a research/trial study. Before you decide it is important for you to understand why the research/study is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends, relatives and your treating physician/family doctor if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. **What is the purpose of the study?**

The background and aim of the study should be given here.

4. **Why have I been chosen?**

You should explain how and why the patient/volunteer was chosen and how many other patients will be studied. Explain if the patient/volunteer with the following can be included in the study for e.g. pacemaker, pregnant women, breast feeding women, surgical clips, artificial heart valve, small bowel endoscopy capsule, metallic implants in the body, prosthesis orthopaedic devices, mentally retarded etc.

5. **Do I have to take part?**

You should explain that taking part in the research is entirely voluntary. States:

–It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still are free to withdraw at any time and without giving a reason.

6. **What will happen to me if I take part?**

You should say how long the patient/volunteer will be involved in the research, how long the research will last, how often and what interval they will need to visit the centre and how long these visits will be. You should explain how long the volunteer will need to come for the study for conducting one experiment and how many experiment/study will be performed each day and if travel expenses are available for each visit. If the volunteer is illiterate then compensation for his/her wage/livelihood for a day is met, if he/she participates in the study? What exactly will happen e.g. blood tests, interviews etc.?

Whenever possible please draw a simple flow chart or plan indicating what will happen at each visit. What are the volunteer's/patient's responsibilities? Set down clearly what you expect of them in the form of simple instructions, for example asking them to come to the Institute at 9.00 am without having eaten anything/on an empty stomach/fasting. You should explain simply and briefly the research methods you intend to use.

7. **What do I have to do?**

Are there any lifestyle restrictions? You should tell the patient/volunteer if there are any dietary restrictions. Can the patient drive? Drink? Take part in sport? Can the patient continue to take his/her regular medication? Should the patient refrain from giving blood? What happens if the volunteer/patient becomes pregnant after performing first visit? Will she still be included in the research study if she needs to come after an interval of months? When and to whom this information has to be passed?

8. **What is the procedure that is being tested?**
   You should include a short description of the drug device. Patients/volunteers entered into study should preferably be given a card (similar to an identity card) with details of the study they are in. They should be asked to carry it if they need to visit a second time.

9. **What are the interventions for the study?**
   For interventional research study the patient/volunteer should be told what is the type of the intervention.

10. **What are the side effects of taking part?**
    For the procedure you should explain to the patients/volunteer the possible side effects. If they suffer these or any other symptoms they should report immediately. You should also give them a contact name and number to phone if they become in any way concerned or in case of emergency. The known side effects should be listed in terms the patient will clearly understand.

11. **What are the possible disadvantages and risks of taking part?**
    For studies where there could be harm to an unborn child if the patient were pregnant or became pregnant during the study, States:
    –It is possible that if the study is performed to a pregnant woman it will harm the unborn Child. Pregnant women must not therefore take part in this study, neither should woman who plan to become pregnant during the study. Women who are at risk of pregnancy may be asked to have a pregnancy test before taking part to exclude the possibility of pregnancy. Women who could become pregnant must use an effective contraceptive during the course of this study. Any woman who finds that she has become pregnant while taking part in the study should immediately inform the investigator.
    Use the pregnancy statement carefully. In certain circumstances (e.g. terminal illness) it would be inappropriate and insensitive to bring up pregnancy.
    You should clearly state what will happen if you detect or find a condition of which the patient was unaware. It is treatable? What are you going to do with this information?

12. **What are the possible benefits of taking part?**
    Where there is no intended clinical benefit to the patient/volunteer from taking part in the study, this should be stated clearly.
    It is important not to exaggerate the possible benefits to the patient during the course of the study/intervention, e.g. saying they will be given extra attention.

13. What if new information becomes available?

If additional information becomes available during the course of the research you will need to tell the patient about this. States:

-Sometimes during the course of a research project, new information becomes available about the research being studied. If this happens, your researcher will tell you about it and discuss with you whether you want to continue in the study. If you decide to withdraw, your researcher/investigator will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

14. What happens when the research study stops?

If the study finishes/stops before the stipulated time, this should be explained to the patient/volunteer. Occasionally the company sponsoring the research may stop it. If this is the case the reasons should be explained to the patient/volunteer.

15. What if something goes wrong?

You should inform patients/volunteers how complaints will be handled and what addresses may be available. Is there a procedure in place? You will need to distinguish between complaints from volunteers as to their treatment by members of staff (research scolars etc.) and something serious happening during or following their participation in the trial, i.e. a reportable serious adverse event.

16. Will my taking part in this study be kept confidential?

You will need to obtain the patient's permission to allow restricted access to their medical records and to the information collected about them in the course of the study. You should explain that all information collected about them will be kept strictly confidential. States:

-If you consent to take part in the research any of your medical records may be inspected by the company sponsoring (and/or the company organizing) the research for purposes of analyzing the results. They may also be looked at by people from the company and from regulatory authorities/IEC to check that the study is being carried out correctly. Your name, however, will not be disclosed outside the laboratory/centre.

-All information collected about you during the course of the research will be kept strictly confidential. Any information which leaves the laboratory will have your name and address removed so that you cannot be recognized from it.

17. What will happen to the results of the research study?

You should be able to tell the patients/volunteers what will happen to the results of the research. You might add that they will not be identified in any report/publication.

18. Who is organizing the research?

The information should include the organization or company sponsoring/collaborating/organizing/funding the research (e.g. Govt. agency, NGO, academic institution).

The patient should be told whether the investigator conducting the research is being paid extra for including and conducting the study. This means who is bearing the cost of the tests/experiments? Is it free? Do the patients/volunteers have to pay for the experiments or results?

19. Will the results of the study be made available after study is over?
Please explain to participant regarding this query.

20. Who has reviewed the study?
You may/should mention that HOD /IRC/IEC of the institution has reviewed and approved the study (you should not however list the members of the Committee).

21. Contact for further information
You should give the patient a contact address for further information. This can be your name or that of another scientist/investigator involved in the study. **Name of the PI, Address, e-mail address, Telephone Numbers and name, Member Secretary of Ethics Committee of the institution (Dr. Lakshmi Bala, Member Secretary, bbdcods.iec@gmail.com) with address, e-mail address with telephone numbers (ext. no. 1291).**

Remember to thank your patient for taking part in the study!

The patient information sheet should be dated
The Participant Information document should state that the participant will be given a copy of the information sheet and the signed consent form.

Signature of PI……

Name……..

Date……..

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ANNEXURE 2B

Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University, Lucknow)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)
प्रतिभागी के लिए सूचना पत्र

1. अध्ययन शीर्षक

क्या आप का अध्ययन शीर्षक एक आम आदमी के समझने योग्य है ? यदि नही,, तो आप एक अतिरिक्त सरल शीर्षक शामिल कर सकते हैं।

2. निमंत्रण अनुच्छेद

आपको समझाना चाहिए कि मरीज को एक अध्ययन/शोध परीक्षण में भाग लेने के लिए कहा जा रहा है. निम्नलिखित एक उदाहरण है.:
आप को एक अध्ययन/शोध परीक्षण में भाग लेने के लिए आमंत्रित किया जा रहा है। इससे पहले आपके लिए यह समझना जरूरी है कि यह अध्ययन क्यों किया जा रहा है और उसमें क्या चीजे शामिल है। कृप्या अपना समय निकालकर इस सूचना को पढें तथा अपनी इच्छानुसार अपने मित्रों , परिजनो तथा अपने चिकित्सक के साथ चर्चा करें। अगर आपको कोई जानकारी समझ में नही आती है या और चाहिए तो हमें बताए। आप अपना समय निकालकर इस सूचना को पढें और बताए कि आप अध्ययन में भाग लेना चाहते है कि नहीं

3 अध्ययन का उद्देश्य क्या है ?

पृष्ठभूमि और अध्ययन के उद्देश्य की जानकारी सरल शब्दों में यहाँ देनी चाहिए।

4 मुझे इस अध्ययन के लिए क्यों चुना गया है ?

कृप्या आप प्रतिभागी को बताए कि उसे क्यों चुना गया है और इस में और कितने लोगो का चुनाव किया जाना है।

5 क्या इसमें मुझे भाग लेना चाहिए ?

कृप्या आप भागी को समझाए कि अनुसंधान / परीक्षण में भाग लेने के पूरी तरह स्वैच्छिकता है। आप निम्नलिखित पैराग्राफ का इस्तेमाल कर सकते है :–
" यह आप पर निर्भर है कि आप को भाग लेना चाहिए की नहीं । यदि आप भाग लेने का फैसला करते है तो आप को अपने पास रखने के लिए एक सूचना पत्र दिया जाएगा और एक सहमति फार्म पर हस्ताक्षर करने के लिए कहा जाएगा। यदि आप ने भाग लेने के लिए फैसला किया फिर भी किसी भी समय बिना कारण वापस भाग न लेने के लिए स्वतंत्र है।

6 मुझे क्या होगा यदि मैं इस अध्ययन में भाग लेता हूँ।

आपको यह बताना चाहिए कि प्रतिभागी को कितने समय के लिए अध्ययन में भाग लेना है और यह अध्ययन कितने समय चलेगा। प्रतिभागी को यह भी बताना होगा कि भागी को कितनी बार और कितने दिनों के लिए परीक्षण के लिए सी0 बी0 एम0 आर0 आना होगा। आप प्रतिभागी को यह भी बताए कि उसे सी0 बी0 एम0 आर0 आने जाने का खर्च किसे देय होगा ? आप भागी को यह भी बताए की उसे आने पर हर बार कौन सी जॉच करनी होगी। आप प्रतिभागी को यह भी बताए कि उसकी क्या जिम्मेदारी होगी। प्रतिभागी को यह लिखकर दीजिए की उसे क्या सावधानी बरतकर आना चाहिए। आप प्रतिभागी को अध्ययन के विभिन्न पहलू के बारे में जानकारी दीजिए।

7 मुझे क्या करना है ?

क्या अध्ययन में भाग लेने से जीवन शैली पर किसी तरह का फर्क पडेगा ? आप भागी को यह भी बताए कि उसे आहार में कोई सावधानी बरतनी होगी। आप प्रतिभागी को यह भी बताए कि क्या वह रोज कि तरह गाडी चला सकता है ? क्या वह खेलखूद में भाग ले सकता है ? क्या वह रोज की तरह दवाए ले सकता है? क्या उसे रक्त देने से बचना चाहिए ? आप यह भी बताए कि उसे गर्भवती हो जाने पर क्या करना चाहिए ।

8 किस प्रकिया का परीक्षण किया जा रहा है ?

आप को प्रकिया या डिवाइस का एक संक्षिप्त विवरण देना चाहिए। आप को उनके विकास के बारे में जानकारी देना चाहिए। आप को दवा की खुराक और और उसे देने की विधि के बारे में जानकारी देना चाहिए। यदि मरीज को दवा के परीक्षणों में शामिल किया जाता है तो उसे अध्ययन की जानकारी का एक पहचान पत्र जैसा कार्ड देना चाहिए।

9 इस शोध में कौन से हस्तक्षेप दिए जायेगें ?

शोध के लिए रोगी को आप यह बताए कि उसे कौन से हस्तक्षेप दिए जायेगे।

10. इस अध्ययन में भाग लेने के क्या दुष्प्रभाव है ?

किसी भी नई शोध या प्रकिया के लिए आप प्रतिभागी को उसके संभव दुष्प्रभाव को समझा जाना चाहिए। यदि वे इन या किसी भी अन्य लक्षण से पीडित है तो उन्हें अगली बार जब आप से मिलने आए तो उन्हे बताना चाहिए। आप भी उन्हे अपना नाम और फोन नंबर देना चाहिए ताकि यदि वे किसी भी आपातकालीन

स्थिति में आप से संपर्क कर सके । ज्ञात दुष्प्रभाव को भागी को सरल भाषा में समझकर तथा लिखकर देना चाहिए। किसी भी नई शोध के लिए अज्ञात दुष्प्रभाव के बारे में रोगी को पता होना चाहिए।

11. इस अध्ययन में भाग लेने के सम्भावित जोखिम और नुकसान क्या है ?

अध्ययन के पहले या उसके दौरान महिला यदि गर्भवती हो जाती है तो बच्चे पर नुकसान हो सकता है, उसे आपको इन शब्दों में बताना होगा:–

" यह संभव है कि अगर एक गर्भवती महिला को शोध के लिए चुना गया है तो उसे इस अध्ययन में भाग लेना चाहिए या नही ? या जो औरत अध्ययन के दौरान गर्भवती होने की संभावना है और कुछ महीने के बाद दोबारा इस अध्ययन में भाग लेना है या नही । किसी भी औरत को यदि पता चलता है कि वह गर्भवती बन गयी है , तो उसे तुरन्त अन्वेषक को सुचित करना चाहिए। गर्भावस्था के बयान को सावधानी से करें ।

12. अध्ययन में भाग लेने के संभावित लाभ क्या हैं ?

क्या प्रतिभागी को अध्ययन में भाग लेने से कुछ फायदा है? यह स्पष्ट रूप से कहा जाना चाहिए। यह महत्वपूर्ण है अध्ययन के बारे में प्रतिभागी को बढाचढाकर नही बताना चाहिए । बल्कि उसे इस भाषा में समझाना चाहिए:

हमें आशा है कि परीक्षणों से आपको मदद मिलेगी। हालांकि यह गारंटी नही हो सकती ,इस अध्ययन से प्राप्त जानकारी हमें भविष्य में लोगो की बीमारी के बारे में जानकारी मिल सकती है।

13 क्या होगा यदि कोई नई जानकारी उपलब्ध हो जाती है ?

यदि अनुसंधान / परीक्षण के दौरान अतिरिक्त नई जानकारी उपलब्ध हो जाती है आप इस बारें में प्रतिभागी को बताऐं । आप निम्न शब्द इस्तेमाल कर सकते है:

" कभी कभी एक अनुसंधान परियोजना / परीक्षण या शोध के दौरान नई जानकारी उपलब्ध हो जाती है। यदि ऐसा होता है तो आपके चिकित्सक आपको इसके बारे में बताएगे और आप के साथ चर्चा करेगे कि क्या आप इस अध्ययन में भाग लेना जारी रखना चाहतें है या नही । यदि आप वापस लेने का फैसला करते है तो आपका चिकित्सक आपके शोध को जारी रखने की व्यवस्था करेगे । यदि आप अध्ययन में जारी रखने का निर्णय लेते तो आपको एक अपडेटेड सहमति फार्म पर हस्ताक्षर करने के लिए कहा जा सकता है।

इसके अलावा नई जानकारी प्राप्त होने पर आपका चिकित्सक आपके हित के लिए अध्ययन से वापस लेने के लिए कह सकता है । वह इन कारणों को आपको बताएगें और इलाज जारी रखने की व्यवस्था करेगें।

14. क्या होता है जब अध्ययन / शोध परीक्षण बन्द हो जाता है ?

अगर यह शोध समय से पहले समाप्त हो जाता है तो इसकी पुरी सुचना प्रतिभागी को देना अनिवार्य है। कभी–कभी जो संस्था शोध को आर्थिक रूप से सहायता प्रदान कर रही होगी उसकी मदद न करने से शोध बन्द हो जाता है । अगर यह एक कारण है तो इसकी जानकारी प्रतिभागी को देनी चाहिए।

15. क्या होगा अगर कुछ गलत हो जाता है ?

प्रतिभागी को सुचित करना चाहिए कि उसकी शिकायतो का निवारण कैसे होगा और जिनके पास शिकायत करनी , उनके पते क्या है ? आपको शिकायत करने की प्रकिया की के विषय में पूर्ण जानकारी देनी होगी एवं शोध के दौरान किसी भी प्रकार के अप्रिय घटना घटने के पश्चात उन्हें कहाँ सम्पर्क करना है उसकी जानकारी उन्हें देनी होगी ।

16. मेरे इस अध्ययन में भाग लेने को गोपनीय रखा जाएगा ?

आपकों प्रतिभागी के चिकित्सीय प्रपत्र की पूर्ण जानकारी देने के लिए प्रतिभागी से आज्ञा लेनी पडेगी। आपको यह बताना होगा जो भी जानकारी प्राप्त की जाएगी वह गोपनीय रखी जाएगी। इसका निम्न वर्णन है।

" यदि आप शोध में भाग लेने की सहमति देते है परीक्षण के लिए आपके मेडिकल रिकार्ड / परिणामों का विश्लेषण जॉच प्रायोजित कंपनी द्वारा किया जा सकता है । यह कंपनी और नियामक अधिकारियों द्वारा अध्ययन सही ढंग से किया जा रहा है की नही इसे देखने के लिए किया जाता है। आपका नाम का अस्पताल / क्लिनिक और प्रयोगशाला के बाहर खुलासा नही किया जाएगा "

" सभी अनूसंधान / परीक्षण के दौरान आप के बारे में एकत्र जानकारी कडाई से गोपनीय रखी जाएगी । कोई भी जानकारी है जो अस्पताल/ क्लिनिक और प्रयोगशाला से बाहर जाएगी , तो उसके ऊपर से नाम और पता हटा दिया जाएगा।

17. अध्ययन / शोध परीक्षण के परिणाम का क्या होगा ?

आप को रोगी के अनुसंधान / परीक्षण के परिणाम को यह बताना होगा कि आगे उसका क्या होगा । आप को यह भी समझाना होगा की उसकी पहचान किसी भी रिपोर्ट /प्रकाशन में नही की जाएगी।

18. इस अध्ययन को कौन आयोजित कर रहा है और इस परीक्षण के लिए धन कहाँ से आएगा ?

कौन सी संस्था या कंपनी शोध कार्य को प्रायोजित/सहयोग/वित्त पोषण (जैसे सरकारी एजेंसी,एन0 जी0 ओ0 , शैक्षिक संस्थान) कर रही है। इसकी जानकारी यहाँ उल्लेखीत होनी चाहिए।

प्रतिभागी को इसकी जानकारी देना होगा कि शोधकर्त्ता जॉच के लिए उन्हें अलग से कोई धनराशि देगे या नही? जिस शोध में वह भाग ले रहे है । इसका तात्पर्य है कि उस जॉच अथवा परीक्षण की जो कीमत है उसका वहन कौन कर रहा है? क्या वह फ्री है ? क्या प्रतिभागी को इस परीक्षण के लिए कोई शुल्क देना होगा या नही?

19. क्या सेवाएं शोध खत्म हो जाने के बाद उपलब्ध रहेगी या नही ?

इस जानकारी की कृप्या आप सूचना पत्र में शामिल करें ।

20. इस अध्ययन का पुर्ननिरिक्षण किसने किया है ?

आप यह बताए कि इसका पुर्ननिरिक्षण या पुर्नावलोकन हमारे संस्थान की नैतिकता / आचार समिति ने किया है तथा अध्ययन करने की सहमति दी है ।

निम्न लोगो से सम्पर्क करें

21. अधिक जानकारी के लिए

आपको प्रतिभागी को अधिक जानकारी देने के लिए मरीज का संपर्क पता देना चाहिए जो अन्वेषक के नाम पर है

प्रमुख अन्वेषक का नाम , पता , ई मेल पता , दूरभाष नं0 और नाम , संस्था की नैतिकता समिति के सदस्य सचिव (डा0 लक्ष्मी बाला , सदस्य सचिव,)

bbdcods_iec@gmail.com) दूरभाष नं0 :– 1233

1 , प्रतिभागी को धन्यवाद अवश्य प्रदान करे।

2 , प्रतिभागी सूचना पत्र में दिनांक लिखित है

3. प्रतिभागी सूचना पत्र में इसकी जानकारी अवश्य हो कि इसकी एक प्रतिलिपि आपने प्रतिभागी को दिया है।

प्रमुख अन्वेषक के हस्ताक्षर

प्रमुख अन्वेषक का नाम ..... दिनांक.....

ANNEXURE 2C

RAYDENT

CBCT CENTRE ,MAHANAGAR

9/13/2022

CONSENT FORM

This is to certify that Dr.Priyanka Khanna is conducting a study titled 'Assessment of relationship between the floor of maxillary sinus and palatal root tip of maxillary first molar using CBCT volumetric imaging' using data from Raydent CBCT diagnostic center and I as the owner of the center have no objection in providing with the necessary data required for the study.

RAYDENT CBCT Centre Mahanagar Lucknow

Dr. Vasu S. Saxena
Raydent CBCT Centre
Lucknow

Date: 13/9/22

raydent

c-12 A vigyanpuri ,mahanagar,lucknow,226006.
Contact: 09621133227,0522-3560145

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ANNEXURE 3

BABU BANARASI DAS UNIVERSITY

BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"Assessment Of The Relationship Of Palatal Root Tip Of Maxillary 1st Molar With Maxillary Sinus Floor Using Computed Tomography Volumetric Imaging: A Retrospective Study"** submitted by **Dr Priyanka Khanna** Postgraduate student in the **Department of Oral Medicine & Radiololgy** for the Thesis Dissertation as part of MDS Curriculum for the academic year 2021-2024 with the accompanying proforma was reviewed by the Institutional Research Committee in its meeting held on **14th September, 2022** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Dr. Puneet Ahuja
Chairperson

Dr. Mona Sharma
Co-Chairperson

ANNEXURE 4

BABU BANARASI DAS UNIVERSITY
BBD COLLEGE OF DENTAL SCIENCES, LUCKNOW

BBDCODS/IEC/09/2022 **Dated: 16th September, 2022**

Communication of the Decision of the X th Institutional Ethics Sub-Committee Meeting

IEC Code: 35

Title of the Project: Assessment Of The Relationship Of Palatal Root Tip Of Maxillary First Molar With Maxillary Sinus Floor Using Computed Tomography Volumetric Imaging: A Retrospective Study.

Principal Investigator: Dr Priyanka Khanna **Department:** Oral Medicine & Radiology

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr Priyanka Khanna,

The Institutional Ethics Sub-Committee meeting comprising following members was held on 15th September, 2022.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry
2.	Dr. Praveen Singh Samant Member	Prof. & Head, Department of Conservative Dentistry & Endodontics
3.	Dr. Jiji George Member	Prof. & Head, Department of Oral Pathology & Microbiology
4.	Dr. Amrit Tandan Member	Professor, Department of Prosthodontics and Crown & Bridge
5.	Dr. Rana Pratap Maurya Member	Reader, Department of Orthodontics & Dentofacial Orthopaedics

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.
The comments were communicated to PI, thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 16/09/22

Prof. Dr. Puneet Ahuja
Principal
BBD College of Dental Sciences
BBD University, Lucknow
16/9

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

Dr. Lakshmi Bala
Member-Secretary
Institutional Ethics Sub-Committee (IEC)
BBD College of Dental Sciences
BBD University, Lucknow

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

ANNEXURE 5

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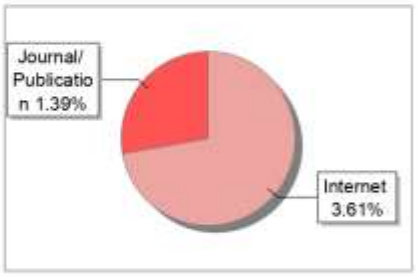
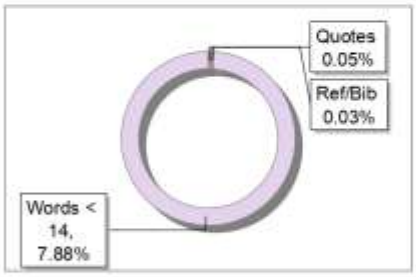
Submission Information

Author Name	Priyanka Khanna
Title	Assessment of the relationship of palatal root tip of maxillary first molar with maxillary sinus floor in both coronal and sagittal section using computed tomography volumetric imaging (CBVI): A retrospective study
Paper/Submission ID	1490669
Submitted by	amarpal.singh056@bbdu.ac.in
Submission Date	2024-03-04 11:01:52
Total Pages	39
Document type	Dissertation

Result Information

Similarity 5 %





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4	3dj.gums.ac.ir	<1	Internet Data
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