“A CROSS-SECTIONAL STUDY OF GENDER DETERMINATION BY COMPUTED TOMOGRAPHY SCAN AIDED ANTHROPOMETRIC ANALYSIS OF MAXILLARY SINUS”

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
CT	Computed tomography
PNS	Paranasal sinuses
CT-PNS	Computed tomography scan of paranasal sinuses
MS	Maxillary sinus
SS	Sphenoid sinus
FS	Frontal sinus
SD	Standard deviation
CBCT	Cone beam computed tomography
AP	Antero-posterior
SI	Superoinferior
ML	Mediolateral

ABSTRACT

TITLE: A CROSS-SECTIONAL STUDY OF GENDER DETERMINATION BY COMPUTED TOMOGRAPHY SCAN AIDED ANTHROPOMETRIC ANALYSIS OF MAXILLARY SINUS

Objectives:

Gender determination using maxillary sinus dimensions and volume in computed tomography of paranasal sinuses.

Methods:

A one year study was undertaken and 88 computed tomography scans of paranasal sinuses were evaluated and anatomical variations of maxillary sinus were studied in males and females.

Results:

A total of 88 scans were studied. There had been 55 males (62.5%), and 33 females (37.5 %). Significant difference has been observed between male and females with volume scores at right side (t=2.4287, p=0.0172). It means that, the males have significant higher volume scores as compared to females in right side.No significant difference has been observed between male and females with volume scores at left side (t=1.9444, p=0.0551). It means that, the males have non-significant higher volume scores as compared to females in left side. Significant difference has been observed between male and females with volume scores of average of right side and left sides (t=2.3811, p=0.0195). It means that, the males have significant higher volume scores as compared to females at average of right side and left sides.

No significant difference has been observed between male and females with scores of dimensions of volume i.e. AP(cm)(p=0.1439), ML(cm)(p=0.0688) and SI(cm) at right side(p=0.0864). It means that, males have non-significant higher scores of dimensions of volume i.e. AP(cm), ML(cm) and SI(cm) as compared to females in right side.No significant difference has been observed between male and females with scores of dimensions i.e. AP(cm)(p=0.1292), ML(cm)(p=0.1851) and SI(cm) at left side(p=0.1954). It means that, the males have non-significant higher scores of dimensions of volume i.e. AP (cm), ML (cm) and SI (cm) as compared to females in left side

Conclusion:

The findings of this study show that men and women have different anatomy when it comes to Maxillary Sinus. Males have much higher right side Maxillary Sinus volume measurements than females, although this difference is not statistically significant when it comes to sexual dimorphism analysis. The left-sided Maxillary Sinus volume is also larger in males; this difference is statistically significant. In this study, males have larger right and left sides of Maxillary Sinus than females which isn’t statistically significant .However, research by Ayyildiz and Akgunlu et al. shows that male and female MS diameters differ statistically significantly. Suresh et al. also had achieved statistically significant results. Gender identification can be aided by precise measurements of the maxillary sinus acquired through CT imaging.

Keywords: Gender determination, CT-PNS, , maxillary sinus

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INTRODUCTION

Forensic anthropology encompasses various fields of study, incorporating sufficient anatomical knowledge that facilitates accurate human identification using cost-effective methods. Understanding anatomy is essential in situations like mass casualties, natural calamities, charred remains, and bodies that have significantly decomposed, particularly when skeletal fragments are the sole evidence available for identification. Several techniques for person identification based on comparisons between ante and postmortem data have been developed in the forensic sciences.

Dental[2] evidence, biological methods like DNA analysis, and fingerprints are crucial tools for identifying people. The two skeletal bones that most clearly exhibit sexual dimorphism are the skull and the pelvis.

While[2] surrounding bones may distort severely, maxillary sinuses (MS) are known for their ability to retain their anatomical shape and structure after fires. Because of this feature, MS size and volume are crucial for forensic applications.

The nasal mucosa[3] invaginates into lateral nasal wall, frontal, ethmoid, maxilla, and sphenoid bones throughout foetal life to form the paranasal sinuses. The great deal of anatomical variety can be explained by this special development.

MS[4]is known as 1st paranasal sinus to form, beginning in 3rd month of pregnancy. At around 11–12 weeks of pregnancy, the primordial ethmoidal infundibulum starts to develop lateral to the uncinate process in the mid-meatus, and also a channel forms inferolateral toward the precursor of the maxillary bone. The primordial MS is formed by this. By 20 weeks of pregnancy, the MS has extended into the ossifying maxilla as a consequence of the surrounding nasal capsule's progressive resorption. All directions of growth occur, but the most notable expansion is anterior-posterior, providing the structure with an elongated oval shape. During embryonic development, the MS is filled with amniotic fluid, which afterwards becomes aerated. Fetal MS can be identified by magnetic resonance imaging starting in the 22nd week of pregnancy largely owing to this prenatal fluid content. Between[4] one and six months of life, the MS fully aerated, based on early postnatal radiographs.

Based on recent studies, however, show that occurrence of this over a considerably longer period and that maxillary sinus opacification rates are comparatively high even in children in good health. One study found that roughly 50% of children under the age of 13 have some form of sinus opacification. It has been suggested that this opacification could be caused by an easily occluded ostia, an abundance of tears.

As people age, the MS's morphological shape changes. From an anterior perspective, the most prevalent shapes are the rectangle from ages 1 to 3, the triangle from ages 4-12, and inverted triangle from ages 13 and up.

MS[4] is approaching adult size by the ages of 15 to 18, but growing continues into the third decade of life. MS volume was around $1.6cm^3$ at 1 to 3 years and 12.6 cm^3 at 22-25 years, per a study that employed automatic 3D segmentation. According to some research, male and female MS growth is comparable during childhood, but sexual dimorphism emerges in late adolescence. Adult studies confirm that males have larger maxillary sinuses.

Comprising two air-filled cavities, MS are situated in the maxillary bone. It might originate in a variety of forms and dimensions. There are thin walls in maxillary sinuses.

Frontal sinuses[5] (FS) are two pyramid-shaped chambers posterior to superciliary arches between frontal bone's anterior and posterior tables. An intersinus septum divides them, and orbit's roof forms sinus floor. FS outflow tract aids posteromedial sinus floor drainage.

Secretions descend frontal infundibulum to form a narrow gap inside the front ethmoidal cells upon passing through thin frontal ostium and into the frontal recess[6]. Following that, this cleft size increases posteriorly and inferiorly before draining into middle meatus. Complex anatomy of frontal recess is influenced by a count of surrounding structures and anatomical variances, that also includes agger nasi, frontal cells, and anterior ethmoidal cells.

3rd or 4th month of fetal life is when FS[4], last paranasal sinuses develop and emerge. At anterosuperior level of middle nasal meatus, they originate "as an outpouching of lateral nasal wall. Ethmoidal cells and frontal recess are the result of this outpouching, that continues superomedially. Anterior ethmoidal cells, ethmoidal infundibulum, suprabullar recess, or a combination of these could give rise to FS, although it is typically formed with rudiments in frontal recess. This leads to numerous nasofrontal connections and a complex drainage" system.

At one to two years old, the FS begins to pneumatize the frontal bone's horizontal plate. By three years old, it has advanced superiorly to the level of the nasion, above the anterior ethmoidal cells. It becomes radiographically visible in most children between the ages of 4 and 7 and reaches the level of the orbital roof before pneumatizing the frontal bone's vertical plate.

There is an evidence that there is asymmetry in frontal sinus, with the left sinus typically being larger. According to one study, 86% of individuals had asymmetry, and 59% of asymmetrical cases had a larger left sinus (Kanat et al., 2015). This can partially be explained by the fact that left sinus continues to enlarge until the age of 25, whereas right sinus typically stops growing between the ages of 16 and 18. According to one 3D reconstructive study, the Frontal Sinus volume was roughly 0.5 cm^3 in children ages 1 to 3 and rose to roughly 4.5 cm3 by the time they were 22 to 25.

The sphenoid bone contains the cuboidal sphenoid sinuses[4]. Among the paranasal sinuses, they are the most posterior. Sphenoid sinus is characterized by central intersinus septum, side clivus, and front ethmoidal cells. It drains into superior nasal meatus via spenoethmoidal recess.

SS[4] develops when nasal mucosa invades bottom portion of cartilaginous nasal capsules during third month of pregnancy. Consequently, pouch resembles fundamental sinus forms. The sphenoidal conchae are formed by the ossification of the anterolateral walls during the fifth month. Up until the age of three, the postero-inferior development persists until merging with the sphenoid bone. The anterior clinoid process, hypophyseal fossa, optic strut, and pterygoid canal are all parts of the sinus. Medial growth eventually causes the intersinus septum to thin.

Employing a 3D segmented model, a Korean study[7] (n=260) discovered that volumes rose from 0.018 cm3 at one year of age to 3.418 cm3 at twenty-five. Most growth takes place between the ages of 14 and 16. There is disagreement about whether sexual dimorphism in sphenoidal sinus size occurs; some research suggests that males have larger sinuses, while other studies show no difference.

The ethmoidal cells, that connect the orbit and nasal cavity, resemble a labyrinth. It is composed of many air cells with thin bone walls separating them. Lamina papyracea, fovea ethmoidalis, sphenoid body, lacrimal, and frontal bones constitute lateral, superior, posterior, and anterior boundaries. Basal lamella divides ethmoidal cells into anterior and posterior. Middle meatus' anterior ethmoidal cells interact with frontal recess, infundibulum, and bulla.

Posterior ethmoidal cells, often smaller and larger, proceed to supreme meatus.

Average volume was 0.409 cm^3 at birth, according to 3D reconstruction research, and rose to 4.462 cm^3 by age of 25. With front cells maturing before posterior ones, the ethmoidal cells in the paranasal sinuses are the first to reach full development. Although growth can continue until age of 15 or 18, research indicates that adults often reach their full size by the time they are 12 years old.

One excellent imaging method for evaluating signal-nasal cavities is computed tomography (CT) scans. They give a nearly perfect evaluation of extent of sinus pneumatization, paranasal sinuses, and craniofacial bones. This technique provides in-depth information that traditional radiographs cannot provide. Gender identification is aided by CT measurements of the maxillary sinuses.

Sexual dimorphism occurs when sexes of the same species change in size or shape. Sexual dimorphism in the MS is observed in a variety of species. According to some research, male and female maxillary sinus growth is comparable during childhood, but sexual dimorphism becomes apparent in late adolescence. Research on adults shows that men have larger maxillary sinuses, which lends greater support to this.

Several[8] MS measurements have been employed for assessing gender and sexual dimorphism in current research.

AIMS AND OBJECTIVES

- Gender determination using maxillary sinus dimensions and volume in computed tomography of paranasal sinuses.

REVIEW OF LITERATURE

Computed Tomography Scanning:

Ionizing radiation is used in computed tomography (CT), a method of investigation that utilizes multi-slice helical scanners that can acquire 32–64 slices. By revolving around the patient on a longitudinal axis, the X-ray tube makes it easier to transmit X-rays from different projections into the body. The electronic detectors assess the strength of the X-rays after they have passed through the body. This technology offers a versatile and enhanced representation of the scanned structure while minimizing movement and artefacts due to the rapid acquisition of images. Each slice of data contains information stored within the computer. The acquired images are confined to a single plane, and the structures of interest can be examined in additional planes through the multiplanar reconstruction technique. Bony[9] and soft tissue structures can be evaluated in several planes with the help of CT scans.

Development of the nose:

A[11] complete understanding of the subject should be attained by analyzing development of nose along with paranasal sinuses in combination with development of face. Most of the facial development usually takes place between weeks four and eight of intrauterine life, when mass of undifferentiated swellings at fetus's anterior end grows and remodels to create a distinctively human profile.

By 4th week, primitive mouth (stomodeum) has 5 facial swellings, where face develops. These swellings consist of 2 maxillary processes, 2 mandibular processes, and a centre unpaired structure called the frontonasal process. Within 1st pharyngeal arch are the mandibular and maxillary processes. Ectodermal tissue proliferates downward across the forebrain, resulting in the frontonasal process.

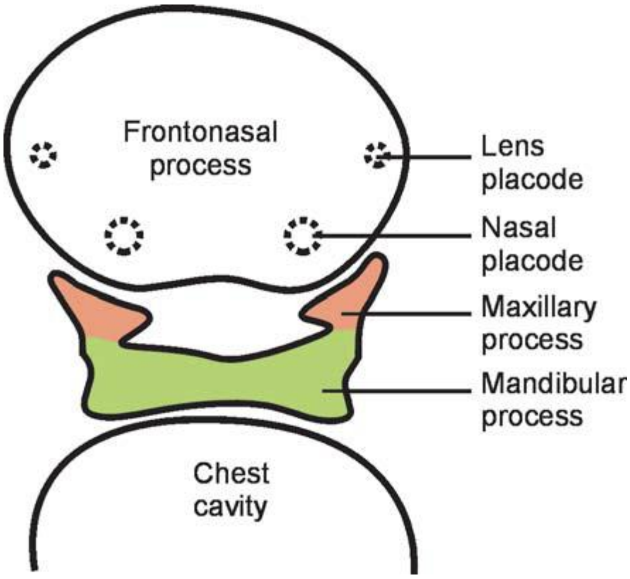


Fig. 1: The 5-week embryo—Formation of facial processes

Nasal placodes 2 "ectodermal thickenings appear on frontonasal process in 5th week of embryonic development. Ectoderm at center of each nasal placode invaginates" in 6th week, forming an oval nasal pit. Lateral and medial nasal processes begin at these nasal pits' brought-up margins. (Fig. 1.2).

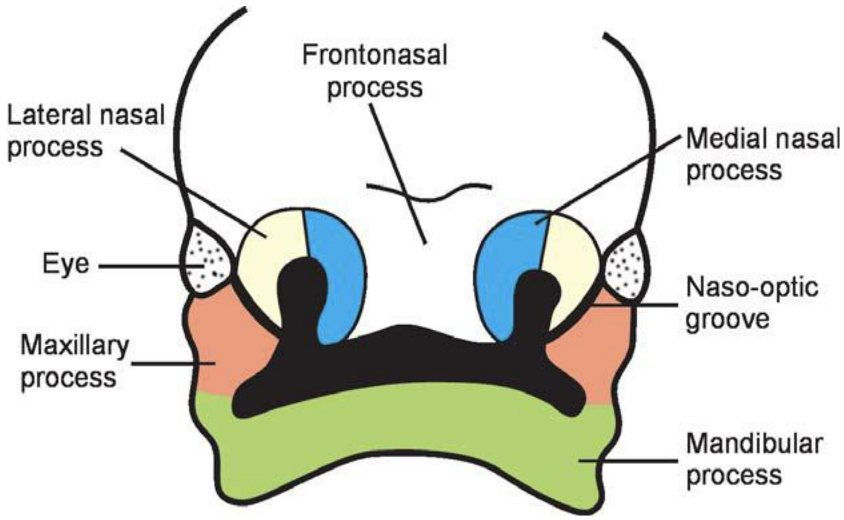


Fig. 2: The 6-week embryo

The maxillary processes on both sides significantly increase and move medially throughout the sixth and seventh weeks of development. The convergence of the medial nasal processes toward one another is facilitated by the maxillary processes medial migration. First fusing with lateral nasal process, then medial nasal process, maxillary processes continue their medial development. The nasal pits and the stomodeum are successfully separated by this series of actions. (fig 1.3)

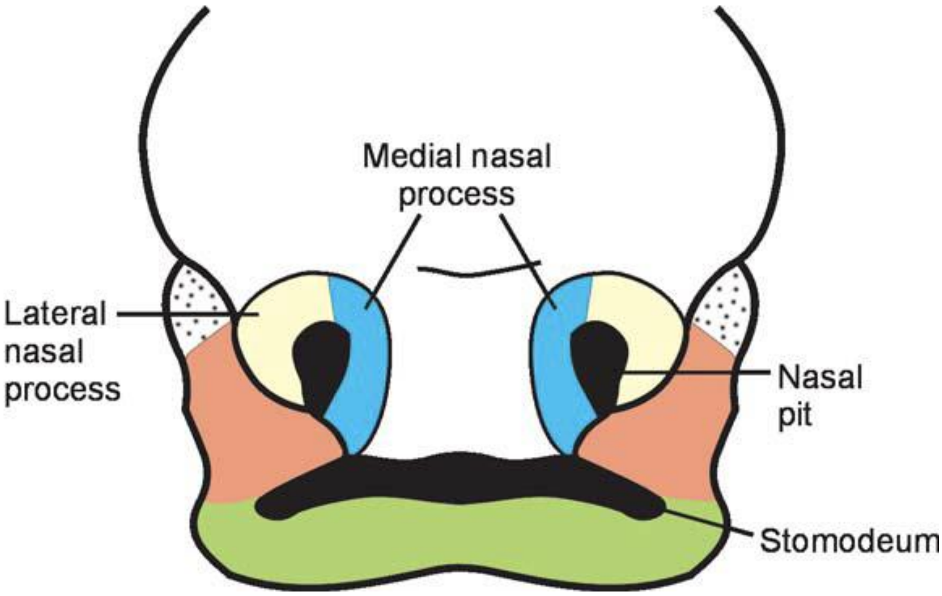


Fig. 3: The 7-week embryo—medial migration of maxillary process

To produce the intermaxillary process, the medial nasal processes merge. In humans, the nasal prominence is created by the elevation of the core tissues of the intermaxillary process. At nasolacrimal or naso-optic groove, maxillary processes further fuse with lateral nasal processes, marking point of their fusion. By 7th week of growth, the underlying structures start to absorb this groove.

The cranial vault's volume at birth is seven times more than the facial skeleton's. Throughout childhood and infancy, this ratio steadily declines. 4 pairs of paranasal sinuses and teeth development are main causes of this alteration[11].

Nasal cavity's invaginations into nearby bones are origin of sinuses. During the fetal stage, notably in the third and fifth months, respectively, the maxillary and ethmoid sinuses form. A elongated sac is the maxillary sinus's initial appearance in newborns. When the deciduous teeth erupt, it experiences a dramatic expansion, growing 5 times in height and width and three times longer in the anteroposterior dimension. Therefore, in adults, "floor of maxillary sinus, which is located above nasal cavity floor" at birth, is located below it. Prior to the age of two, the ethmoid sinuses are comparatively tiny. From then on, they undergo a rapid growth phase that lasts until the age of six or eight. However, they continue growing until they reach adolescence.

<u>Development of paranasal sinuses:</u>

During third month of foetal development, paranasal sinuses start to form. While the sphenoid sinus develops from an outpouching of nasal capsule, maxillary, frontal, and ethmoid sinuses originate from outpouchings of nasal cavity's lateral wall. Maxillary and ethmoid sinuses are only ones completely formed at birth[12].

<u>Development of the Maxillary Sinuses:</u>

Located in the nasal capsule, directly below uncinate process in uncibullous groove, MS is first sinus to form[13]. It began as an extension from lateral nasal wall. It commences as fluid-filled cavity and maintains this condition at birth.

The maxillary sinus undergoes significant growth following birth, experiencing rapid development during the first three years of life. This growth rate subsequently slows before undergoing another period of rapid enlargement between the ages of seven and twelve. It is estimated that during these phases of rapid growth, the maxillary sinus increases in vertical dimensions by approximately 2 mm and expands Antero posteriorly by about 3 mm each year.

Because of the maxillary sinus's pneumatization, which spreads inferiorly towards the nasal cavity floor and laterally towards lateral orbital wall, maxillary sinus and maxillary dentition are close together.

<u>Development of the Ethmoid Sinuses:</u>

During third month of foetal development, lateral evaginations originating from the middle meatus initiate formation of anterior ethmoidal cells[14]. Subsequently, evaginations from superior meatus contribute to development of posterior ethmoidal cells.

Anterior ethmoidal cells development take place before second ethmoturbinal, in contrast, the posterior cells originate behind this structure. The drainage pathways from these sinuses are different as a result of this variation anterior ethmoids drain through middle meatus, which is situated in front of basal lamella, and posterior ethmoids drain through superior meatus, which is situated beyond middle turbinate's basal lamella[15].

Ethmoid sinuses represent the most variable structures among the sinus cavities and are filled with fluid at the time of birth. They initially present as spherical in shape and undergo a process of flattening, reaching their approximate adult dimensions by age of 12.

<u>Development of the Frontal Sinuses:</u>

A protrusion forms in the middle meatus's anterosuperior area during third month of pregnancy. This creates the frontal recess, which at birth appears as a small diverticulum. The frontal sinus then grows by directly expanding from the frontal recess, which occurs through the pneumatization of an ethmoid air cell found within the frontal recess or ethmoid infundibulum[16]. When children were 1 to 3 years old, the frontal sinus was about 0.5 cm^3, and by the time they were 22 to 25 years old, it had grown to around 4.5 cm^3. The high standard deviations (SD) show significant variety within populations, and even with cross-sectional imaging, there is a lot of diversity[17].

Development of the Sphenoid Sinuses:

Sphenoid sinus develops as an outpouching of posterior nasal capsule in 4th month of development and remains small until around age 3, when it pneumatizes into bone. By the age of 7, it has expanded to level of sella turcica, making it earliest paranasal sinus to achieve complete development.

Gender Determination in Forensic Science:

The first stage in identifying someone is figuring out their sex, mainly because sex-related patterns are followed when evaluating other characteristics like age, ancestry, and height[8]. The greatest degree of sexual dimorphism is seen in the pelvic bone, followed by the skull bones. However, larger bones may be fragmented, have more postmortem changes, and be more susceptible to damage during mass disasters or fire calcination, hence cervical vertebrae and teeth have been investigated for sex determination.

Morphometric procedures rely on the anthropologist's ability to evaluate bone landmarks and take measurements to create discriminant functions for sex estimation. These approaches can achieve a level of accuracy that exceeds 80% in determining sex and are considered valuable.

Recently, advancements in computer-aided measurements have integrated technology into standard forensic practices. Geometric morphometrics and 3D reconstructions of bone characteristics or structures from CT images or MRI allow forensic identification to employ quantitative methods with exceptional precision. CT and MRI are increasingly being employed in forensic investigations because they offer useful information about anatomical structures without compromising their spatial relationships. However, the effectiveness of these techniques is also contingent upon the observer's ability to execute the protocol accurately to minimize interobserver error above 10%.

Significant sexual dimorphism is observed in the skull, particularly in the frontal bone, frontal sinuses, mandible, teeth, cervical vertebrae, and maxillary sinuses.

Frontal bone:

The forehead is positioned at a sharper angle, and the glabellae and supraciliary arches are more prominent in skulls of male than in skulls of female[8]. Conversely, a more pronounced frontal importance and a more upright forehead are characteristics of female crania.

Frontal Sinus:

Width and height measurements of FS, which are generally larger in men, form a combination of dimensions.

Mandible:

Mandible contains lower dental arch and articulates with skull via temporomandibular joint[8]. Because men's masticatory forces are greater than women's and their muscular attachments are more defined, the male mandible has a coarser texture.

Dentition:

The dental arch serves a vital function in the human identification procedure8. Teeth are significant in forensic medicine due to their robust chemical composition, as well as their mechanical and thermal properties, which ensure the preservation of dental structures during postmortem decomposition.

The teeth of males tend to be larger than those of females. This principle is true for all types of teeth, however, upper and lower canines exhibit most pronounced differences between the sexes. Canine teeth are particularly noteworthy in sexual estimation due to their exceptional durability against injury and gum disease, as well as showing a marked difference in size between males and females.

Cervical Vertebrae:

Atypical atlas (C1) and axis (C2) are the most suitable cervical spine sex-determining vertebrae[8]. Considering males have more muscle, bone, and brain weight than women, their atlas may bear more weight. Skull base and atlas are closely joint. Vertebral foramen in atlas and upper and lower articular surfaces are more pronounced in men.

Maxillary Sinus:

MS volume differs significantly among male and female. Male MS is larger and wider than female MS.

Anatomy of Maxillary Sinus:

Orbital floor at superior aspect, palatine ascending process laterally, maxillary bone anteriorly, and pterygomaxillary space posteriorly form anatomical borders of MS cavity[12]. Internal maxillary artery, the sphenopalatine ganglion, foramen rotundum, vidian canal, and larger palatine nerve are among significant anatomical features found in pterygomaxillary region.

The adult maxillary sinus is a pyramidal structure, with approximate dimensions of 34mm in the anteroposterior direction, 33mm in the vertical orientation, and 25mm in the horizontal axis. With an adult volume of 15ml[12], MS typically consists of single pyramidal chamber.

The maxillary ostium, an elliptical opening that connects mucociliary drainage into the ethmoid infundibulum, is situated close to MS anteromedial roof.

Differences in the structure of MS can be observed, such as incomplete septa (50%), duplication of the sinus (2.5%), presence of accessory ostia (25%), and hypoplasia (6%)/aplasia (< 1%).

Innervation

MS receives most sensory information from posterior superior alveolar nerve. MS has frontal and mucosal innervation from anterior and middle superior alveolar nerves. Anterior ethmoidal branch of V1 nerve supplies the infundibulum, while palatine nerve supplies maxillary ostium. On maxilla's front, "anterior superior and middle superior alveolar nerves branch differently. In addition to trigeminal sensory nerve branches, facial nerve secretomotor fibers start in nervus intermedius, synapses at pterygopalatine ganglion, and go to sinus mucosa". Sympathetic carotid plexus is the origin of the vasoconstrictor branches.

Vascular Supply

Lateral branches of sphenopalatine, larger palatine, alveolar arteries, and infraorbital artery, give blood to MS. In addition to the jugular and dural sinus networks, venous drainage from sinus extends backward into maxillary vein and forward into facial vein.

Lymphatic

A superficial and deep longitudinal network of sinus mucosal lymphatic capillaries targets MS's natural ostium. From the dorsal to the ventral and from the cranial to the caudal regions, the lymphatic concentration increases, peaking at the natural ostium. The lymphatic network reaches the nasopharynx at this point and joins the nasal arteries directly. Pterygopalatine plexus connects nasopharynx, eustachian tube, and ostial duct for lymphatic drainage. The principal lymphatic basins to paranasal sinuses are lateral cervical and retropharyngeal lymph nodes.

Radiological anatomy of Maxillary Sinus:

Because it offers a detailed view of the region's bony architecture and acts as an essential "road map" for the operating surgeon, CT scan is considered the gold standard for investigations in all preoperative instances[10]. MS appearance in axial and coronal regions of CT scans related to paranasal sinus will be examined in this study.

Osteomeatal complex should be first coronal scan focus since it displays MS ostium[18]. Below the bulla in the pictures is the uncinate process. Hiatus semilunaris and infundibulum form crevice between uncinate process and bulla, maxillary sinus ostium. This anatomy is known as "osteomeatal unit". The scan reveals MS ostium. Anterior and posterior fontanelles have supplementary ostia. This region illustrates MS as triangular. In upper MS, infraorbital nerve may be dehiscent. Posterior MS is oval instead of triangular.

Axial sections depict nasolacrimal duct as a circular aperture near MS's anteromedial corner. MS's medial wall is thinner than its thicker anterolateral walls. Pterygopalatine fossa and medial and lateral pterygoid plates can be observed posteriorly. Medially, nasal cavity and pterygopalatine fossa interact through sphenopalatine foramen. It extends to infratemporal fossa laterally. MS's anterior, posterolateral, and medial walls are simpler to investigate with axial slices, however coronal sections provide assesment of roof and floor.

Methodology for measurement of maxillary sinus dimensions-

Once various slices in the coronal and axial sections were examined, the largest measurement was obtained[19]. Both the left as well as right maxillary air sinuses were measured for the following parameters:

1. Longest distance between most anterior and posterior points on an axially reconstructed image was used to calculate the antero-posterior dimension (Photo 1).

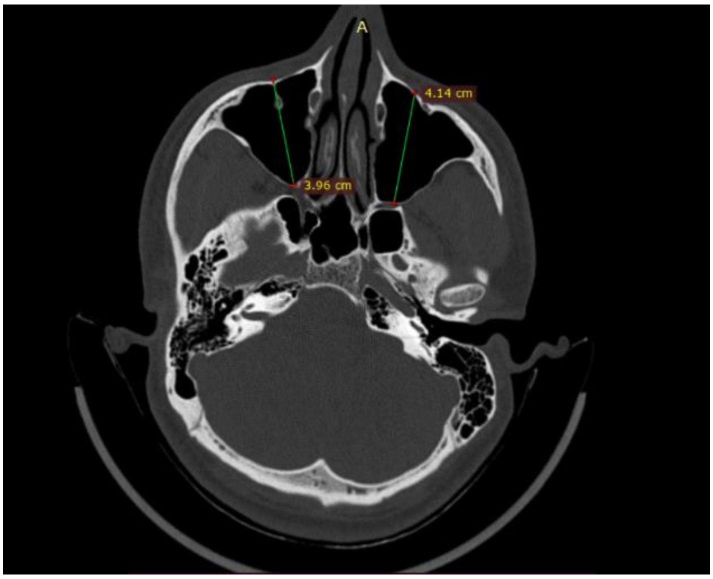


PHOTO 1-TAKING MEASUREMENTS OF ANTEROPOSTERIOR DIMENSION OF AXIAL CUT OF CT PNS PLAIN

2.Longest distance between lowest point of sinus floor and highest point of sinus roof was utilized for calculating height of sinus using coronal reconstructed image(Photo 2).

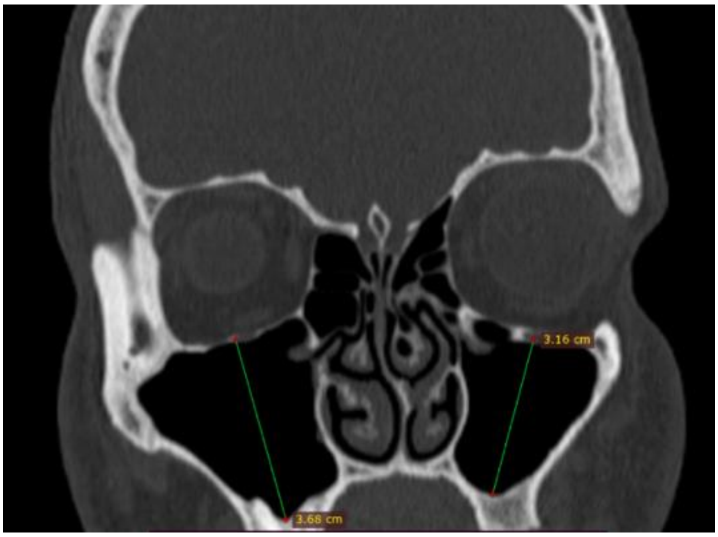


PHOTO 2 -TAKING MEASUREMENTS OF SUPEROINFERIOR DIAMENSION OF AXIAL CUT OF CT PNS PLAIN

3.The breadth was determined by measuring the axially reconstructed image and had been described as the largest distance, measured perpendicularly, between the maxillary sinus's medial wall and outermost point of its lateral wall (Photo 3).

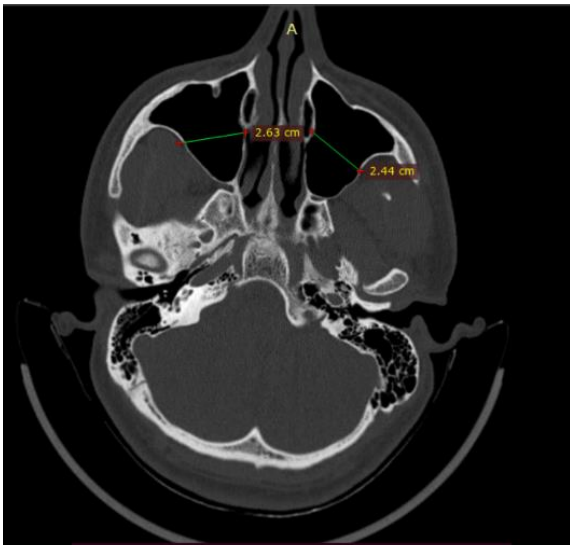


PHOTO 3- TAKING MEASUREMENTS OF MEDIOLATERAL DIAMENSION OF AXIAL CUT OF CT PNS PLAIN

4. The maximum dimensions of each side's maxillary air sinuses were measured, and approximate volume of each sinus had been determined manually by employing the following mathematical formula: (height breadth AP diameter 0.52).

MATERIALS AND METHODS

Source of Data:

The patients at "KLE's Dr Prabhakar Kore Hospital & Medical Research Centre", Belagavi, will have a computed tomography scan of their paranasal sinuses.

Study Design:

Cross sectional study

Study Period:

1 year

Sample Size:

Sample Size: 88

At 95% confidence interval and 80% power

n= (Z1- α/2 + Z1- β)2

n=43.3

n ≅44

required sample size=44x2=88

where $\bar{x}1$=25.12 -ML dimension of maxillary sinus in female

where $\bar{x}2$= 28.53-ML diameter of maxillary sinus in male

SD1=6.75

SD2=4.26

Sampling technique:

The study's participants include those who had paranasal sinus computed tomography scans at “KLE's Dr Prabhakar Kore Hospital & Medical Research Centre”, Belagavi's Department of Radiology. Following patient's informed consent, their information and a comprehensive clinical history will be gathered to ensure that the inclusion as well as exclusion criteria are met.

Inclusion Criteria:

1. Patients with intact permanent dentition who are older than eighteen.
2. No history of previous sinus surgery/trauma.

Exclusion Criteria:

1. Patients below 18 years of age.
2. CT scans displaying conditions with abnormal midfacial development or craniofacial anomalies.
3. CT scans showing MS with pathological abnormalities.

Study protocol:

The patients who will undergo computed tomography scan in “KLE's Dr Prabhakar Kore Hospital & Medical Research Centre”, Belagavi. Patients who will undergo CT PNS are for preoperative assessment of paranasal sinuses before surgery, malignancy, chronic sinusitis, to rule out any cysts or polyps, acute rhinosinusitis.

After taking informed consent from the patient, their details and matching of the exclusion and inclusion criterion.

Data collection procedure:

- Mediolateral (ML),superoinferior (SI), and anteroposterior (AP) dimensions, in addition with volumes of right and left MS, will be measured using CT by employing the RadiAnt DICOM viewer.
- Longest distance between most anterior and posterior points Antero posteriorly is known as AP dimension, and it will be measured on an axially reconstructed image.
- A coronal reconstructed image will be used to measure "SI dimension, or height of the sinus, which is longest distance between lowest point of sinus floor and highest point of sinus roof.
- ML dimension, also referred to as width of sinus, is maximum distance measured on an axially reconstructed image that is perpendicular to median wall of sinus and outermost point of lateral wall of" MS.
- "Paint on slices" feature on the workstation will be employed to measure MS volume.
- Following analysis of every slice in axial and coronal sections, measurements have been collected.

Data processing and analysis/statistical analysis:

My study plan is as follows because the study is observational.

The mean and SD will be computed for continuous and quantitative variables. The continuous variables will be compared using appropriate statistical methods, that include the student unpaired t test, if the data is split into two groups with specific qualitative characteristics. Median could be utilized to quantify discrete variables. Rates, ratios, and percentages would be employed for expressing categorical data. Chi square test, test for proportion, and Fisher's exact test will be employed to explore correlations between outcome, clinical, and demographic factors. We'll employ non-parametric testing for discrete variables. In addition to the aforementioned, appropriate tools such as ANOVA, correlation, regression, etc., will be employed based on necessity. The comparison will be displayed using appropriate graphs. A p-value of less than 5% (0.05%) can be considered significant for all tests.

RESULTS

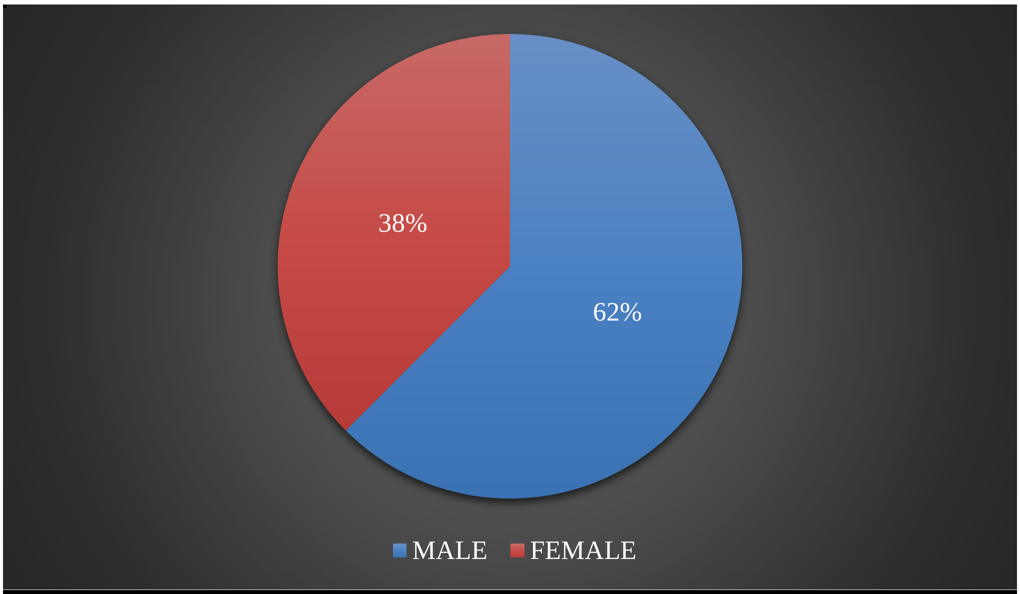
CT-PNS scans of 88 patients were studied in "Department of Otorhinolaryngology and Head & Neck Surgery" of "KAHER's Jawaharlal Nehru Medical College" from March 2023 to February 2024.

All recorded observations are described under following headings.

Table 1: Gender Distribution

GENDER	TOTAL	PERCENTAGE
MALE	55	62.5%
FEMALE	33	37.5%
TOTAL	88	100%

Graph 1: Gneder Distribution

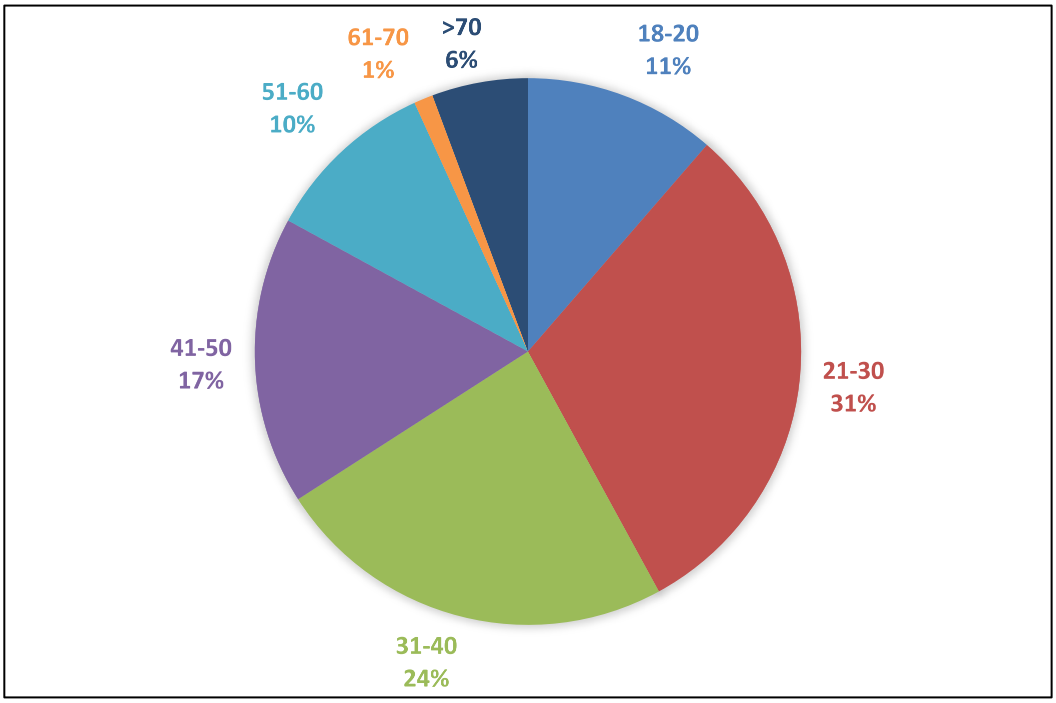


A total of 88 scans were studied. There had been 55 males (62.5%), and 33 females (37.5 %).

Table 2: Age Distribution:

AGE	TOTAL	PERCENTAGE
18-20	10	11
21-30	27	31
31-40	21	24
41-50	15	17
51-60	9	10
61-70	1	1
>70	5	6
TOTAL	88	100

Graph 2: Age Distribution



In "this study population, the mean age was 36.36 years.

Among the study population, 10 cases were aged between 18-20 years (11%), 27 cases between 21 to 30 years (31%), 21 cases were aged between 31 to 40 years (24%), 15 cases were aged between 41 to 50 years (17%), and 15 cases were above 50 years" (17%). On plotting the age distribution of samples there was a maximum concentration of the samples between the ages of 21-30 years followed by 31-40 years.

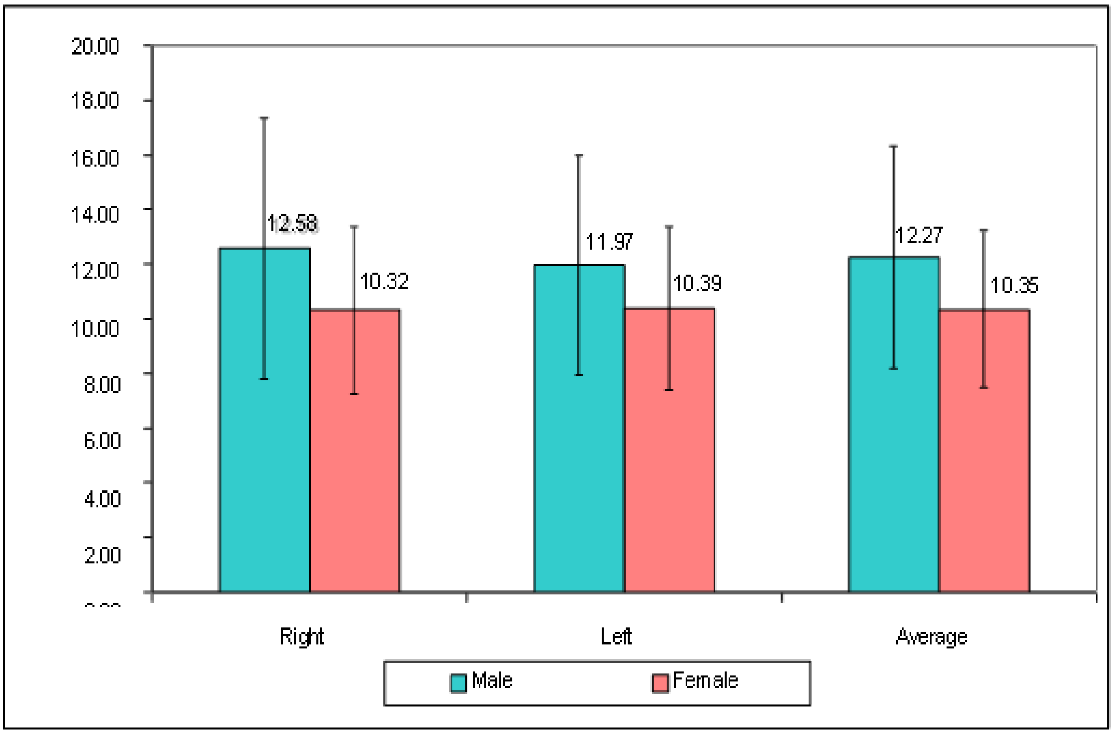
GENDER COMPARISION OF MAXILLARY SINUS VOLUME:

Table 3: Comparison of male and female with volume scores at right and left side by independent t test

Volume at	Male		Female		Effect size	t-value	p-value
	Mean	Std.Dev.	Mean	Std.Dev.			
Right(cc)	12.58	4.79	10.32	3.08	0.5755	2.4287	0.0172*
Left(cc)	11.97	4.03	10.39	3.01	0.4479	1.9444	0.0551
Average(cc)	12.27	4.06	10.35	2.87	0.5545	2.3811	0.0195*

*p<0.05

Graph 3: Gender Comparision Of Maxillary Sinus Volume



- Significant difference has been observed between male and females with volume scores at right side (t=2.4287, p=0.0172). It means that, the males have significant higher volume scores as compared to females in right side

- No significant difference has been observed between male and females with volume scores at left side (t=1.9444, p=0.0551). It means that, the males have non-significant higher volume scores as compared to females in left side.

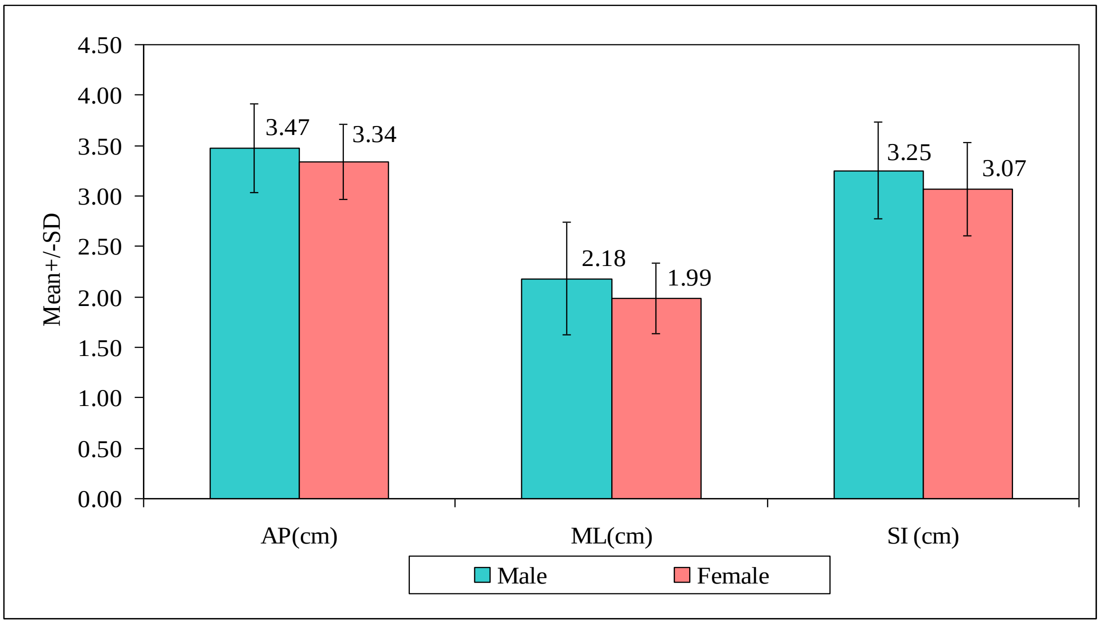
- Significant difference has been observed between male and females with volume scores of average of right side and left sides (t=2.3811, p=0.0195). It means that, the males have significant higher volume scores as compared to females at average of right side and left sides

GENDER COMPARISION OF MAXILLARY SINUS DIMENSIONS ON RIGHT SIDE:

Table 4: Comparison of male and female with dimension at right side by independent t test-

Dimensions	Male		Female		Effect size	t-value	p-value
	Mean	Std.Dev.	Mean	Std.Dev.			
AP(cm)	3.47	0.44	3.34	0.37	0.3336	1.4749	0.1439
ML(cm)	2.18	0.56	1.99	0.35	0.4402	1.8428	0.0688
SI (cm)	3.25	0.48	3.07	0.46	0.3846	1.7345	0.0864

Graph 4: Comparison of male and female with dimension at right side



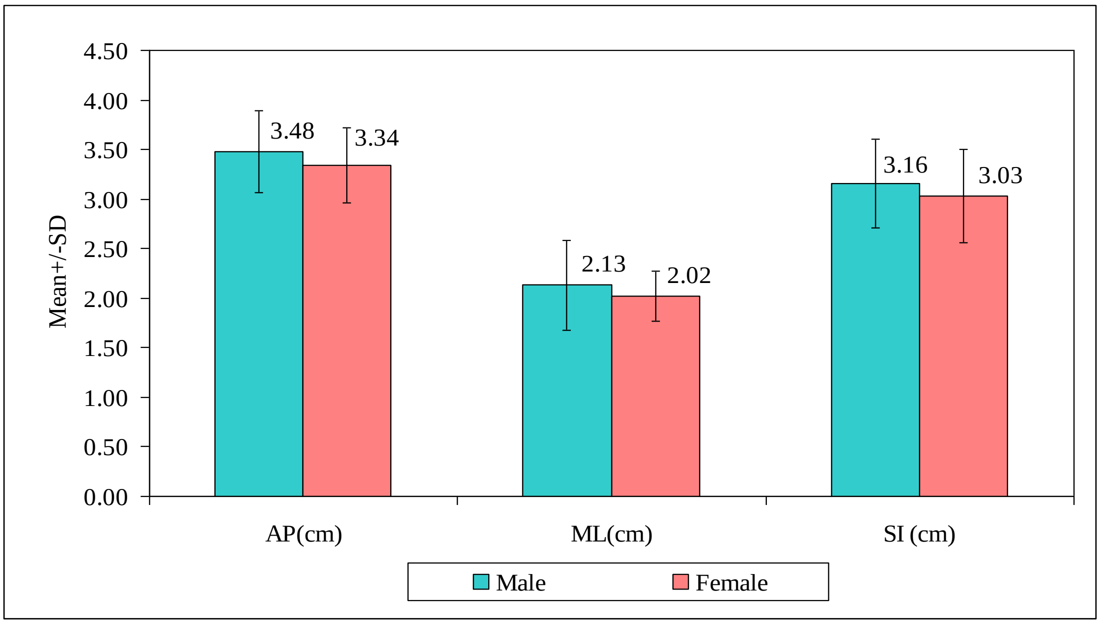
- No significant difference has been observed between male and females with scores of dimensions of volume i.e. AP(cm)(p=0.1439), ML(cm)(p=0.0688) and SI(cm) at right side(p=0.0864). It means that, males have non-significant higher scores of dimensions of volume i.e. AP(cm), ML(cm) and SI(cm) as compared to females in right side.

GENDER COMPARISION OF MAXILLARY SINUS DIMENSIONS ON <u>LEFT SIDE:</u>

Table 5: Comparison of male and female with dimension scores at left side by independent t test

Dimensions	Male		Female		Effect size	t-value	p-value
	Mean	Std.Dev.	Mean	Std.Dev.			
AP(cm)	3.48	0.41	3.34	0.38	0.3406	1.5319	0.1292
ML(cm)	2.13	0.45	2.02	0.25	0.3249	1.3358	0.1851
SI (cm)	3.16	0.45	3.03	0.47	0.2859	1.3048	0.1954

Graph 5: Comparison of male and female with dimensions at left side

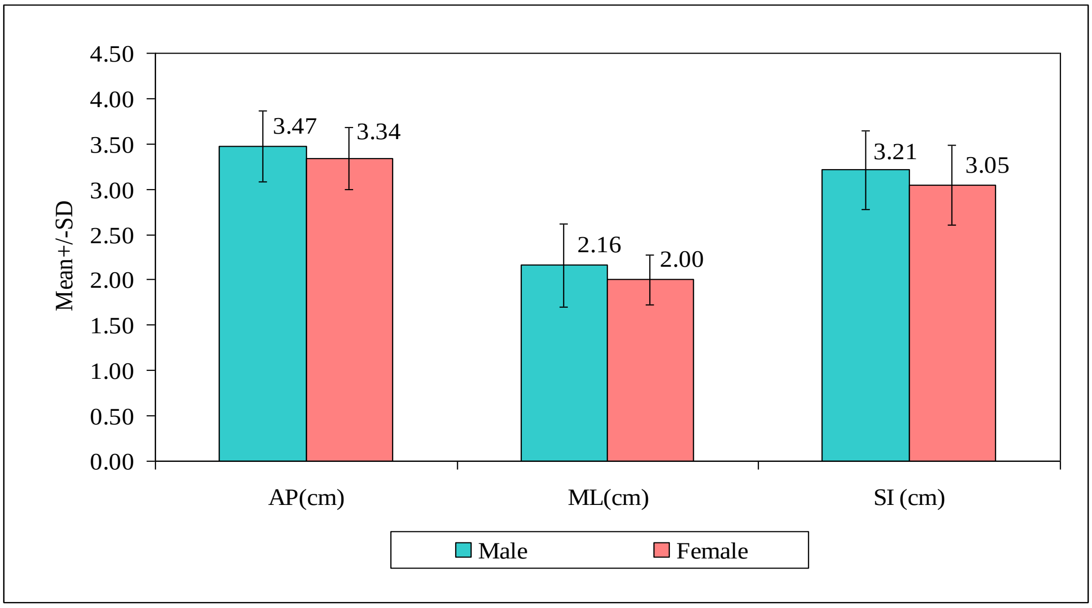


- No significant difference has been observed between male and females with scores of dimensions i.e. AP(cm)(p=0.1292), ML(cm)(p=0.1851) and SI(cm) at left side(p=0.1954). It means that, the males have non-significant higher scores of dimensions of volume i.e. AP (cm), ML (cm) and SI (cm) as compared to females in left side.

Table 6: Comparison of male and female with dimension of maxillary sinus with average of right and left side by independent t test

Dimensions	Male		Female		Effect size	t-value	p-value
	Mean	Std.Dev.	Mean	Std.Dev.			
AP(cm)	3.47	0.39	3.34	0.34	0.3719	1.6555	0.1015
ML(cm)	2.16	0.46	2.00	0.27	0.4318	1.7855	0.0777
SI (cm)	3.21	0.44	3.05	0.44	0.3545	1.6089	0.1113

Graph 6: Comparison of male and female with dimension scores with average of right and left side



- No significant difference had been noted between male and females with scores of dimensions i.e. AP(cm) (p=0.1015), ML(cm) (p=0.0777) and SI(cm) with average of right side and left side (p=0.1113). It means that, the males have non- significant higher scores of dimensions i.e. AP(cm), ML(cm) and SI(cm) as compared to females in with average of right side and left side.

DISCUSSION

Determining gender from skeletal remains is crucial for identification. Anthropometric studies are key in this process. MS can remain intact even in decomposed, burnt, or fragmented remains, making them useful for gender estimation when other indicators are unavailable. Although sinus dimensions vary by population due to factors like race, genetics, and environment, their measurements after puberty are reliable for gender determination. Men typically have a significantly larger MS volume than women.

In this study, 88 patients' CT-PNS images had been examined. There were 33 females and 55 males in the study population. The investigation population had been divided into 5 age groups: "18-20 21-30, 31-40, 41-50,51-60, 61-70 and 70 above". Samples were not taken below 18 so that to exclude incomplete removal of maxillary sinus. The greatest number of samples were from 18 to 30 years old. The sample population had mean age of 36.5yrs.

Volume was measured on every individual CT PNS in axial and coronal sections, and each scan has been evaluated for ML, AP, and SI dimensions. AP dimension has been determined by measuring largest "distance between most anterior and posterior points on an axially reconstructed image. Employing coronal reconstructed image, height of sinus has been determined by taking longest distance between lowest point of sinus floor and highest point of sinus roof". Breadth was determined by measuring the axially reconstructed image and had been described as the largest distance, measured perpendicularly, between the maxillary sinus's medial wall and outermost point of its lateral wall. Sinuses volume has been calculated with simple formula described by Sahlstrand-Johnson et al. "ML dimension×SI dimension×AP dimension)/2"

In our study of 88 CT scans, males showed significantly higher volume scores compared to females on both sides ($t=2.3811$, $p=0.0195$).

Research by "Paknahad et al[20]., Mathew and Jacob[21], Waluyo et al[22]., and Soares et al[23]. indicates that measurements of specific morphological and dimensional features of MS could be beneficial in determining gender and, hence, human identification. The volume" of the MS varies by gender. The mean volume of men was found to be statistically significantly higher than that of women.

Teixeira et al. used 420 CBCT scans from an adult population in Brazil to quantify five linear characteristics of the MS: "width, length, height, inter-sinus distance, and maximal width". Volume was calculated as V (cc)= (height×width×length)×0.5. The authors suggested these measurements as supplementary methods for human identification, with better accuracy for gender than age.

Barros et al.[24] examined CBCT images from 238 Brazilian patients (139 females, 99 males) aged 6 to 68 years. They found that males had significantly greater MS width and overall larger dimensions, with the most pronounced difference in maxillary width.

Camba et al. performed CBCT cranial measurements on 311 Brazilian and Dutch individuals between the ages of 20 and 60. Males had considerably greater measures than females in the majority of 7 linear measurements made in MS.

Ayyildiz and Akgunlu[25] performed a retrospective analysis of 212 subjects over age of 18 to determine MS prevalence variation and dimensions, and their associations with age and gender. Research's results indicate that males had statistically significant greater maxillary sinus widths than females.

According to Suresh et al[26]., the male MS's dimensions and volume were greater than "female's, and the difference has been statistically significant ($p<0.05$) for sinus AP and volume.

A total of 120 CBCT scans from Turkish participants—50 men and 70 women, with an average age of 22.2 years—were studied by Asantogrol and Cosgunarslan. Research results demonstrate statistically significant association between gender and" MS diameters and volumes.

AP(cm)(p=0.1439), ML(cm)(p=0.0688), and SI(cm) dimensions on the right side(p=0.0864), did not significantly differ between males and females. In these dimensions, men's scores were non-significantly higher than women's.

The scores of the dimensions, such as AP (cm) (p=0.1292), ML (cm) (p=0.1851), and SI (cm) on the left side (p=0.1954), did not differ significantly. This shows that the left side's scores for dimensions, like AP (cm), ML (cm), and SI (cm), were not appreciably higher than those of the female side.

Males' MS in this study had mean maximum depths of 3.47 ± 0.44cm "on the right side and 3.48±0.41cm on the left. It was 3.34±0.38cm on the left and 3.34±0.37cm on the right for females. There was no statistically significant difference.

Males' MS had an average maximum depth of 39.3±3.8mm on the right side and 39.4±3.7mm on the left, as per Uthman et al. There was a statistically significant difference between these measurements and the measurements taken for females, which were 36.9±3.8mm on the right side and 37 ± 4mm on left".

Males had a considerably bigger mean maximum depth of the maxillary sinus "(42.58 ± 7.9 mm on the right side and 43.7±7.78mm on the left) than females (37.8 ± 5.69 mm on the right and 37.6 ± 6 mm on the left), according to Teke et al[27]".

In the present study, the mean maximum height of the MS for the male group was 3.25 ± 0.48 cm on the right side and 3.16±0.45cm on the left side. For the female group, the values were 3.07 ± 0.46 cm on the right side and 3.03±0.47cm on the left side. The difference between the two groups was not statistically significant.

Males had an average maximum sinus "height of 43.3±4.8mm on the right side and 45.1±4.1mm on the left, according to Uthman et al[28]. This was much greater than that of girls, who had measurements of 39.9 ± 5.2 mm on the right and 40±4.8mm on the left.

According to Teke et al., average height of male maxillary sinus was 47.6±6.4mm on right side" and "47.2±6.5mm on the left. In females, the recorded values of 45.1±4.6mm on the right side and 43.6±4.4mm on the left side differed statistically significantly.

Male maxillary sinus widths in this study were 2.18 ± 0.56cm on the right and 2.13 ± 0.45 cm on the left". Females' values were lower, measuring 2.00 ± 0.27cm on the left and 1.99 ± 0.35 cm on the right.

Males' MS had an average maximum width of 24.7 ± 4mm on the right and 25.6 ± 4.4mm on the left, according to Uthman et al. The widths were considerably smaller for females, measuring 22.7±3.2mm on "right and 23±4mm on the left.

As per the Teke et al., the average maximum width of the male maxillary sinus was 26.89±5.52mm on left side and 27.19±5.46mm on right". Females had much lower mean values, with the right side measuring 24.44±3.61mm and the left side averaging 24.27 ± 3.98mm.

In a study including 140 participants, Ekizoglu et al[29]. found that females had smaller maxillary sinus dimensions overall.

Males have bigger maxillary sinus dimensions than females, which can help determine sex, according to Ahmed et "al[33].

This is consistent with research conducted by Kim et al[30]., Kiruba et al[31]., and Jasim et al[32]. According to Teke et al., these" discrepancies result from variances in body composition, nutrition, energy intake, as well as heredity.

In Gwalior, India, Sharma et al. compared size of MS in men and women. They discovered a notable variation in depth. Females had lower mean values in the current study, which revealed significant differences in all three dimensions (width, height, and depth).

Males had mean values of MS depth, width, and height of (38, 38), (27, 26), and (34, 33) mm for both sides, according to a research by Pawar et al[34]. in Mumbai. The females measured (37, 36), (26, 26), and (34, 33) mm, in that order. While the current study reveals smaller dimensions in females, this study reported identical average heights of MS in both genders.

MS of recently interred skulls were measured using 3D Multiaxial CT scans in research conducted in South India by Vidya et al[35]. Results demonstrated that the MS in male skulls were larger than those in female skulls.

CONCLUSION

Forensic anthropology involves various fields of study, utilizing anatomical knowledge to accurately identify humans using cost-effective methods. Anatomy knowledge is crucial in situations such as mass casualties, natural disasters, charred remains, and significantly decomposed bodies, especially when skeletal fragments are the only evidence available for identification. Several techniques for person identification based on comparisons between ante and postmortem data have been developed in forensic sciences.

Although the surrounding bones may undergo significant distortion, Maxillary sinus are notable for their unique ability to preserve their anatomical shape and structure even after fire incidents. Consequently, size and volume of Maxillary sinus are essential for forensic applications.

The findings of this study show that men and women have different anatomy when it comes to Maxillary Sinus. Males have much higher right side Maxillary Sinus volume measurements than females, although this difference is not statistically significant when it comes to sexual dimorphism analysis. The left-sided Maxillary Sinus volume is also larger in males; this difference is statistically significant. In this study, males have larger right and left sides of Maxillary Sinus than females which isn’t statistically significant .However, research by Ayyildiz and Akgunlu et al. shows that male and female MS diameters differ statistically significantly. Suresh et al. also had achieved statistically significant results. Gender identification can be aided by precise measurements of the maxillary sinus acquired through CT imaging.

SUMMARY

The study titled "A cross-sectional study of gender determination by Computed tomography scan aided anthropometric analysis of maxillary sinus" was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery of KLE'S Jawaharlal Nehru Medical College and KLE'S Dr. Prabhakar Kore Hospital and MRC, Belagavi from March 2023 to February 2024.

The study included 88 patients who underwent CT-PNS for various indications. The CT scans were collected, and dimensions of maxillary sinus and volumes were studied in RadiAnt DICOM Viewer.

There were 55 males (62.5%) and 33 females (37.5 %). In this study population, the mean age was 36.53 years for males and 36.36 for females.

The MS is known as the first paranasal sinus to form, beginning in the 3rd month of pregnancy.

Volume scores on the right side revealed a significant difference between males and females (t=2.4287, p=0.0172), indicating that males had significantly greater volume scores than females on this side. The mean volume on the right side for male is 12.58 cm^3 and female is 10.32cm^3 . The mean volume on the left side for male is 11.97 cm^3 and female is 10.39 cm^3 .

On the left side, the volume ratings for males and females were not significantly different (t=1.9444, p=0.0551). This finding suggests that males have non-significantly higher volume scores than females on the left side.

When analysing the average volume scores of both the right and left sides, there was a significant difference between males and females (t=2.3811, p=0.0195). This indicates that, on average, males have significantly higher volume scores on both sides compared to females.

The mean dimensions of maxillary sinus in males of left side are AP (3.48cm) ML (2.13cm) SI 3.16(cm); whereas the dimensions in females of left side are AP (3.34cm) ML (2.02cm) SI(3.03cm) .

The mean dimensions of maxillary sinus in male of right side are AP (3.47cm),ML(2.18cm), SI(3.25cm)whereas; the dimensions of maxillary sinus in females of right side are AP(3.34cm),ML(1.99cm) SI(3.07cm) .

No significant difference was observed between male and females with scores of dimensions i.e. AP (cm) (p=0.1439), ML (cm) (p=0.0688) and SI (cm) at right side (p=0.0864). It means that, the males have non-significant higher scores of dimensions i.e. AP (cm), ML (cm) and SI (cm) as compared to females in right side but in studies conducted by Ayyildiz and Akgunlu et al. Suresh et al the results were statistically significant.

No significant difference was observed between male and females with scores of dimensions i.e. AP (cm) (p=0.1292), ML (cm) (p=0.1851) and SI (cm) at left side (p=0.1954). It means that, the males have non-significant higher scores of dimensions i.e. AP (cm), ML (cm) and SI (cm) as compared to females in left side.

No significant difference was observed between males and females in the dimensions, specifically AP (cm) (p=0.1015), ML (cm) (p=0.0777), and SI (cm) with the average of the right and left sides (p=0.1113). This indicates that males have non-significantly higher scores in the dimensions AP (cm), ML (cm), and SI (cm)compared to females when averaging the measurements from both sides.

The study indicates anatomical differences between the sexes in the maxillary sinus. When examining sexual dimorphism, measurements of the maxillary sinus, particularly the volume on the right side, are useful. The volume of the left side is also higher in males than females.

The dimensions of maxillary sinus are also higher in males than females on both sides. CT imaging provides accurate dimensions of the maxillary sinus, which assists in gender identification. It can be used to identify gender in even burnt dead bodies as maxillary sinus remains intact. It can be helpful in gender determination in case of dead bodies who doesn't have pelvic bones or other modes of identification and bodies that have significantly decomposed, particularly when skeletal fragments are the sole evidence available for identification.

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ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

GENDER DETERMINATION USING MAXILLARY SINUS DIMENSIONS AND VOLUME IN COMPUTED TOMOGRAPHY OF PARANASAL SINUSES -CROSS SECTIONAL STUDY

Name of Student/Principal Investigator: _______

Name of Guide/Co Investigators: ____________

____

Introduction: The measurements of maxillary sinus on computed tomography will be measured and will help in predicting the gender of the participant. Paranasal sinuses are present in deeper part of skull so they can resist trauma. It will help in identifying dead body if someone identity cannot be determined by different forensic methods like dental records, fingerprint. The paranasal sinuses are unique so that the sinus patterns of two different individual are not same even in the case of identical twins The need to establish maxillary sinus anthropometry which can assist doctors in identification and to reduce inaccuracies need to be addressed.

Explanation of procedure: If you agree to participate then relevant data will be collected as per the Performa. Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not get any benefits by participating in this study. The data gathered will help population at large. The data will help to identify dead remains which is a very important and noble task.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations: done during the course of study will be paid by the investigator.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: " If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777,Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"Gender determination using maxillary sinus dimensions and volume in Computed tomography of Paranasal sinuses -Cross Sectional Study”.** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE – II

PROFORMA

A CROSS SECTIONAL STUDY OF GENDER DETERMINATION BY COMPUTED TOMOGRAPHY SCAN AIDED ANTHROPOMETRIC ANALYSIS OF MAXILLARY SINUS.

Date:

Name:

IP/ OP No:

Occupation:

Phone No:

Age:

Sex:

Address:

RIGHT MAXILLARY SINUS

SUPEROINFERIOR DIMENSION -

MEDIOLATERAL DIMENSION -

ANTEROPOSTERIOR DIMENSION -

VOLUME-

LEFT MAXILLARY SINUS-

SUPEROINFERIOR DIMENSION-

MEDIOLATERAL DIMENSION-

ANTEROPOSTERIOR DIMENSION-

VOLUME-

ANNEXURE – III

PHOTOS

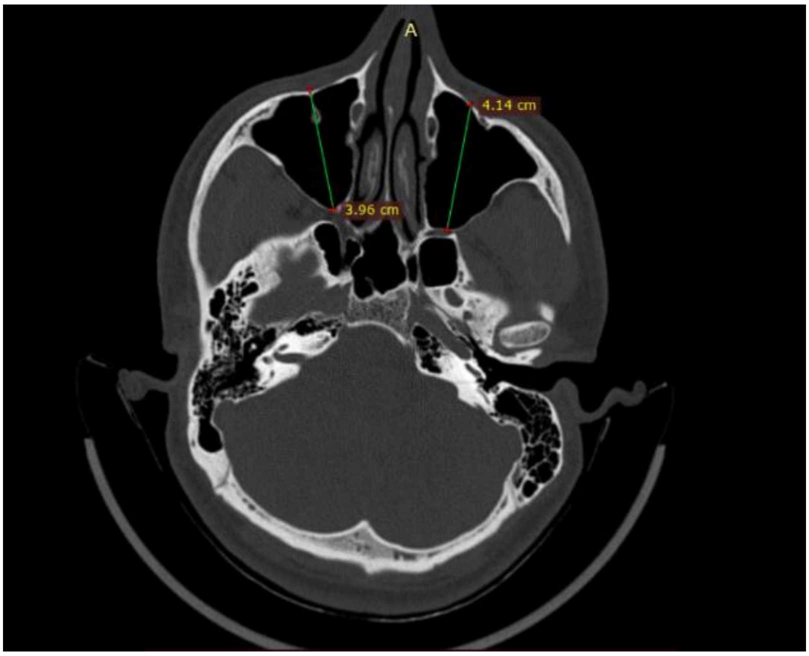

PHOTO 1.TAKING MEASUREMENTS OF ANTEROPOSTERIOR DIMENSION OF AXIAL CUT OF CT PNS PLAIN

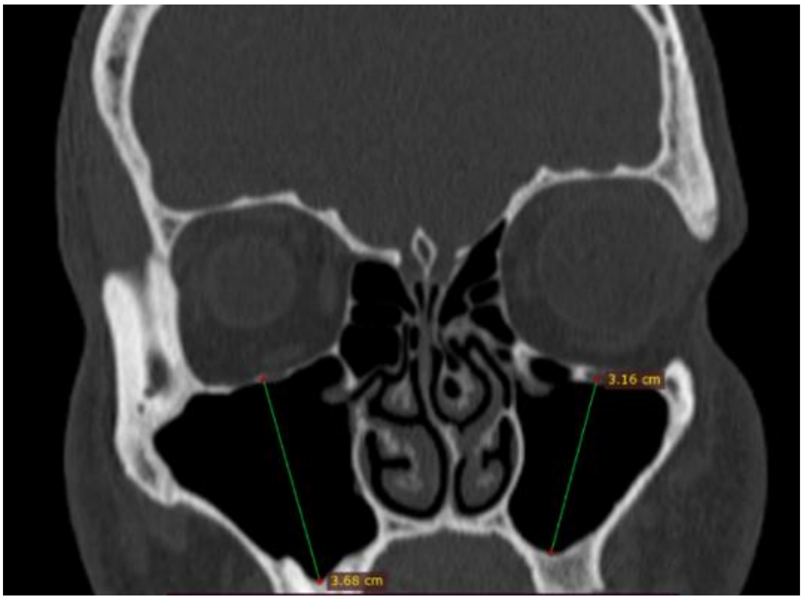

PHOTO 2.TAKING MEASUREMENTS OF SUPEROINFERIOR DIAMENSION OF AXIAL CUT OF CT PNS PLAIN

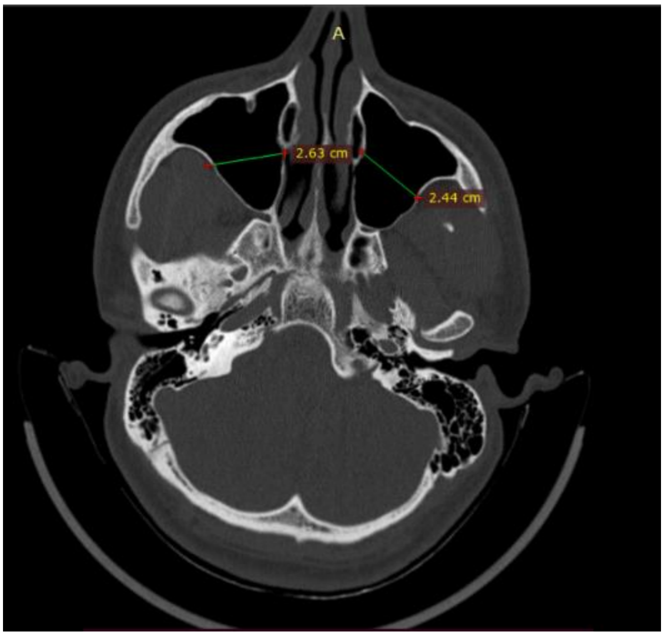

PHOTO 3.TAKING MEASUREMENTS OF MEDIOLATERAL DIAMENSION OF AXIAL CUT OF CT PNS PLAIN

ANNEXURE – IV

KEY TO MASTER CHART:

GLOSSARY	ABBREVIATIONS
PNS	Paranasal sinuses
CT-PNS	Computed tomography scan of paranasal sinuses
MS	Maxillary sinus
AP	Antero-posterior
SI	Superoinferior
ML	Mediolateralal

ANNEXURE – V MASTER CHART

				RIGHT MAXILLARY SINUS				LEFT MAXILARY SINUS			
SN	Age	Gender	IP/OP NO	AP(cm)	ML(cm)	SI(cm)	volume	AP(cm)	ML(cm)	SI(cm)	volume
1	34	M	192062	3.64	2.13	3.51	13.606866	3	1.81	3.37	9.14955
2	21	F	7061779	3.14	1.57	2.22	5.472078	2.97	1.75	2.16	5.6133
3	18	F	7129589	3.76	2.07	3.08	11.986128	3.92	1.92	3.82	14.375424
4	28	F	6994532	3.2	1.7	3.09	8.4048	2.8	1.66	3.15	7.3206
5	24	M	1200740	3.05	1.98	3.27	9.873765	2.88	1.48	3.5	7.4592
6	52	F	71111302	3.08	1.72	2.61	6.913368	3.09	1.84	2.51	7.135428
7	26	F	17972	3.29	1.84	3.62	10.957016	3.38	1.89	3.52	11.243232
8	24	M	17920	3.83	2.16	3.67	15.180588	3.72	2.21	3.27	13.441662
9	21	M	7115266	3.23	2.11	3.6	12.26754	3.1	2.11	3.55	11.610275
10	58	M	1203486	3.39	1.91	2.22	7.187139	3.14	1.74	2.66	7.266588
11	34	F	2.321E+11	3.41	1.79	2.89	8.8201355	3.81	2.13	2.91	11.8077615
12	72	M	7116852	3.88	2.57	3.39	16.901862	3.61	1.95	3.08	10.84083
13	38	F	7122846	3.52	2.1	4.18	15.44928	3.75	2.28	3.71	15.86025
14	22	M	1201693	3.67	2.17	3.83	15.2508685	3.78	2.04	3.58	13.803048
15	21	M	7115273	3.21	1.74	3.25	9.076275	3.32	1.83	2.7	8.20206
16	40	F	15558	3.11	2	2.85	8.8635	3.47	2.11	2.6	9.51821
17	59	M	1194213	3.43	1.68	3.22	9.277464	3.94	2.11	3.11	12.927337
18	26	M	7067053	3.57	1.62	3.69	10.670373	3.74	1.81	3.43	11.609521
19	46	M	1199027	3.83	1.98	3.02	11.450934	3.5	2.28	3.14	12.5286
20	27	M	1196810	3.49	1.96	3.55	12.14171	3.43	2.02	3.67	12.713981
21	32	M	1196792	3.02	2.17	2.44	7.995148	3.05	2.26	2.72	9.37448
22	31	M	6296016	3.29	2.08	3.24	11.085984	3.29	1.93	2.83	8.9848255
23	22	M	10014303	3.41	2.36	3.8	15.29044	3.68	2.82	2.96	15.358848
24	22	M	2.305E+11	3.6	2.04	3.35	12.3012	3.23	2.18	3.11	10.949377
25	25	M	2.305E+11	3.6	2.04	3.35	12.3012	3.23	2.18	3.11	10.949377
26	44	M	1190544	3.06	1.43	2.04	4.463316	2.76	1.16	2.23	3.569784
27	41	M	2967530	4.02	1.75	3.53	12.416775	3.81	1.9	3.78	13.68171
28	40	M	856346	3.92	2.31	3.57	16.163532	4.02	2.46	3.29	16.267734
29	24	M	1190355	3.62	2.04	3.13	11.557212	3.56	2.19	3.15	12.27933
30	21	M	2665274	3.23	4.47	3.83	27.6489615	2.31	3.12	3.41	12.288276
31	47	M	10014236	3.06	1.79	2.04	5.586948	2.33	1.78	1.76	3.649712
32	27	M	10015159	3.04	1.7	3.44	8.88896	3.43	2.24	3.22	12.369952
33	73	F	2197984	3.41	2.08	2.69	9.539816	3.21	2.29	2.89	10.6220505
34	20	M	1188168	3.6	2.02	2.6	9.4536	3.42	2.02	2.73	9.429966
35	36	M	265255	3.26	1.79	3.43	10.007711	3.05	1.77	3.46	9.339405
36	60	M	7222519	3.59	1.97	2.86	10.113389	3.49	1.84	2.86	9.182888
37	26	F	6986406	3.1	1.91	3.22	9.53281	3.48	2.1	2.99	10.92546
38	22	F	10013559	3.37	2.18	3.5	12.85655	3.49	2.15	3.76	14.10658
39	20	M	14995	3.53	2.09	3.4	12.54209	3.86	2.38	3.14	14.423276
40	20	M	23185	3.34	2.2	3.42	12.56508	3.1	2.25	3.23	11.264625
41	23	M	22635	3.3	1.64	3.22	8.71332	3.54	1.57	3.02	8.392278
42	45	M	7211244	3.86	1.85	3.52	12.56816	3.66	1.92	3.33	11.700288
43	39	F	7075499	3.34	2.15	3.27	11.740935	3.45	1.99	2.88	9.88632
44	66	M	23643	3.18	2	3.11	9.8898	3.05	2.16	2.77	9.12438
45	56	M	10010458	3.74	1.75	3.74	12.23915	3.97	1.65	3.28	10.74282
46	46	M	25376	3.93	2.85	3.31	18.5368275	4.1	2.3	3.45	16.26675
47	32	F	10014570	2.94	1.83	2.39	6.429339	3.28	2.15	2.76	9.73176
48	32	F	7218127	3.16	1.5	2.6	6.162	3.19	1.73	2.65	7.3122775
49	26	F	7216874	3.65	1.87	3.16	10.78429	3.61	2.09	3.41	12.8640545
50	50	F	23100264917	3.11	1.58	2.86	7.026734	3.15	1.58	3.1	7.71435
51	49	M	232258	3.94	2.25	3.58	15.86835	3.93	1.85	3.18	11.560095

52	56	F	26939	3.7	1.99	3.35	12.333025	3.38	1.96	3.26	10.798424
53	39	F	26889	3.44	1.87	3.44	11.064416	3.02	1.57	3.54	8.392278
54	31	F	1215341	3.19	2.12	3.38	11.429132	2.99	1.74	3.23	8.402199
55	44	M	73183761	3.79	1.88	2.4	8.55024	4.2	1.96	3.28	13.50048
56	46	M	26923	3.83	1.85	3.33	11.7973575	3.84	2.13	2.91	11.900736
57	20	F	26436	1.99	2.84	2.99	8.449142	2.86	2.04	3.18	9.276696
58	47	M	26730	1.21	3.1	1.83	3.432165	2.78	1.68	1.71	3.993192
59	28	M	26819	2.85	1.57	2.01	4.4968725	2.97	1.7	2.08	5.25096
60	51	M	27914	3.73	1.76	3.49	11.455576	3.43	1.73	3.73	11.0667235
61	82	M	28607	2.99	2.12	3.13	9.920222	3.18	1.63	2.74	7.101258
62	38	M	28972	3.17	1.98	3.06	9.603198	2.79	1.82	2.52	6.398028
63	35	F	29225	3.69	2.17	2.92	11.690658	3.8	2.1	3.11	12.4089
64	71	F	28503	3.14	2.02	2.98	9.450772	2.9	1.8	2.94	7.6734
65	18	M	29146	3.26	1.81	3.46	10.208038	3.14	1.79	3.17	8.908651
66	18	M	292232	3.55	2.26	3.65	14.641975	3.57	2.43	3.52	15.268176
67	35	M	27855	3.55	1.93	3.05	10.4485375	3.55	2.21	2.79	10.9444725
68	22	M	27918	3.14	1.92	3.07	9.254208	3.13	1.75	3.09	8.4627375
69	71	F	291332	3.16	1.79	2.74	7.749268	3.61	1.93	3.02	10.520623
70	26	M	28998	3.65	2.49	3.4	15.45045	3.4	1.84	3.31	10.35368
71	25	F	296598	3.18	1.32	3.05	6.40134	2.88	1.92	2.9	8.01792
72	47	M	10053296	3.97	2.82	3.14	17.576778	3.66	2.68	3.48	17.067312
73	20	M	7429943	3.3	3.31	4.18	22.82907	3.33	3.26	4.27	23.177133
74	18	F	10055680	3.7	3.02	2.96	16.53752	3.28	2.6	2.46	10.48944
75	37	M	887189	3.66	2.99	3.32	18.166044	4.05	3.11	3.35	21.0974625
76	42	M	10051284	3.27	2.03	3.6	11.94858	3.33	2.61	3.56	15.470514
77	27	F	10048761	3.81	1.78	4.2	14.24178	3.57	2.33	3.82	15.887571
78	22	M	2404002977	3.48	1.89	2.99	9.832914	3.59	2.4	3.48	14.99184
79	18	M	7433521	3.24	2.1	3.23	10.98846	3.56	2.81	2.71	13.554878
80	36	F	7204953	4.05	2.57	3.28	17.06994	4.16	2.54	3.33	17.593056
81	33	F	7413087	3.58	2.01	2.97	10.685763	3.41	2.19	3.29	12.2846955
82	41	M	204591	4.19	3.53	3.7	27.362795	3.8	2.29	3.42	14.88042
83	57	M	2104001303	3.47	2.39	3.01	12.4814165	3.52	2.01	2.79	9.869904
84	40	M	10054041	3.58	2.11	3.82	14.427758	3.92	2.18	4.03	17.219384
85	51	F	10055755	3.22	1.92	2.95	9.11904	3.57	2.33	2.45	10.1896725
86	21	F	7428933	3.77	2.31	3.29	14.3258115	3.88	1.98	2.94	11.293128
87	38	M	7405646	3.91	3.52	3.21	22.089936	4.12	3.31	3.21	21.887706
88	41	M	10051860	3.77	2.11	3.26	12.966161	4.09	2.44	3.34	16.665932