"ANATOMICAL VARIATIONS OF THE ANTERIOR SKULL BASE IN PATIENTS UNDERGOING COMPUTED TOMOGRAPHY SCAN OF THE PARANASAL SINUSES"

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LIST OF ABBREVIATIONS

ASB	Anterior Skull BAse
ESS	Endoscopic Sinus Surgery
CSF	Cerebro Spinal Fluid
LL	Lateral lamella
CP	Cribriform Plate
OF	Olfactpry Fossa
mm	Millimeter
cm	Centimeter
PNS	Para-Nasal Sinus
CT	Computerized Tomography
CRS	Chronic Rhino Sinusitis
ACF	Anterior Cranial Fossa
AEC	Anterior Ethmoidal air Cells
PEC	Posterior Ethmoidal air Cells
FPM	Frontal Process of Maxilla
LP	Lamina papyracea
AEA	Anterior Ethmoidal Artery
FE	Fovea Ethmoidalis
CG	Crista Galli
OP	Orbital Plate

NC	Nasal Cavity
NF	Nasal Floor
IOF	Infra Orbital Foramen
NS	Nasal Septum
DNS	Deviated Nasal Septum
Ns	Not significant

ABSTRACT

Background: The anterior skull base and the paranasal sinuses have shown to have varied anatomical variations. Therefore necessitating a need for pre-operative assessment of the paranasal sinuses and the skull base.

Objectives: The objective of the study is to determine the profile of variation in anterior skull base using Computed Tomography of Paranasal Sinuses.

Material and methods: This observational study was conducted in the department of Otorhinolaryngology and Head and Neck Surgery and Department of Anatomy of KAHER's Jawaharlal Nehru Medical College and KLES Dr.Prabhakar Kore Hospital and Medical Research Center, Belagavi from January 2020 to December 2020. 40 CT-PNS Scans were studied and measurements were taken to measure all the parameters. All measurements were recorded and photographs were documented.

RESULTS: 17 Male & 23 Female CT PNS Scans were studied. Different measurements were studied and compared between genders, age groups and right and left sides.

The most common anatomical variation was seen in the nasal septum, showing deviation to the right in 62.5% of the study and 37.5% to the left. Followed by the presence of concha bullosa.

Variations in the ASB, in females on the right Type-II > Type -1 and equally seen on both side in males. On the left Type-I>Type-II in females and males Type-II>Type-I. The presence of AEF was seen in 100% of study population thereby proving to be a reliable landmark for the AEA. There was no defect in lamina papyracea in the study population.

CONCLUSION: With a rapid increase in the need for Anterior Skull Base surgeries in our country, this study assesses the possible anatomical variations that can exist in the Indian population hoping to add up to the present understanding for the Indian paranasal sinuses and skull base dynamics.

Key words- Anterior skull base, Keros, ESS, Olfactory fossa, anterior ethmoidal artery

TABLE OF CONTENTS

LIST OF FIGURES

9.	Anatomical variations seen on CT PNS a) AEC- in its course through the AE cells. b) AES- bony sulcus on lateral walls of the OF, corresponding to AES c) represented by a bony notch on the medial wall of the orbits . d) Supraorbitary pneumatization - ample bilateral supraorbitary pneumatization	15-16

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

INTRODUCTION

A gradual increase in the variety of inflammatory and neoplastic illnesses of sino-nasal cavity and ASB are being treated endoscopically since the start of ESS. As a result of these advancements, surgical intervention is now possible with less patient morbidity.[1] However, The sinuses, eyes, and brain are all in close proximity during these surgeries, necessitating particular attention to the sinonasal and skull base architecture and its variations.[2]

Although the ESS is frequently implemented, it is not without its drawbacks. They are grouped as major and minor complications. Major complications occur in 0-1.5% of cases and they involve CSF leak, injury to orbit & intracranial injury and CSF leak related complications Minor complications such as bleeding, infection, crusting, synechiae formation, ostial stenosis, tooth or lip numbness and recurrence. [3,4,5]

The ethmoid is a complex bone that forms a part of the ASB. Ceiling of which is made by fovea ethmoidalis, which confers to the LL of the CP. [3,5] The phrase "dangerous ethmoid" was initially used by Kainz and stamberger who characterised it based on the depth of the OF , as in keros type III. [6,11]

Asymmetry of ethmoidal roof is extremely important to understand and its associated anatomical variations which play a crucial role in endoscopic sinus surgeries. Understanding the anatomy, disease and variations of the PNS and ASB has become possible with computerised tomography (CT). Therefore an insight about ASB anatomy in sinus surgeries, helps with each patient in preventing complications. [7]

The FS and ASB are located using the anterior ethmoidal artery as a reference. As it traverses the ethmoid sinus from the orbit to the LL of the CP, it is known to display substantial diversity. It also lies embedded in the skull base, thus requiring extensive anatomical knowledge of relevant anatomy.[1]

OBJECTIVE

The rationale of this study is to ascertain the profile in variations in ASB using Computed-Tomography of Para-nasal Sinuses.

REVIEW OF LITERATURE

ESS was first used in the 2nd part of the twentieth century & is widely used to treat nasal polyps, CRS, certain neoplasms of the nose and sinuses as an approach to the ASB and to treat developmental abnormalities. The introduction of ESS has improved the safety and effectiveness of these operations. ESS, like any other therapeutic modality, has the potential to cause problems. Iatrogenic CSF rhinorrhea, for example, is one of the most serious yet rare (incidence estimated at 0.2–0.57%).[3]

The LL of the OF (most frequent), the posterior surface of the frontal recess and region of the AEC are the most usually damaged portions of skull base during ESS. [1]

Floor of ACF is formed by the ASB, which also serves as a 'roof' over the orbits and ethmoid air cell system (sinuses). The frontal bone, ethmoid's CP, lesser wings and the sphenoid's body make up this structure. Orbital portion of frontal bone forms- orbital cavity roof from its superomedial articulation with the nasal bones (the conjoint of these three being the Nasion), to its fusion with the zygomatic bone superolaterally, the anterior aspect being the supraorbital rim; medially, to form the medial orbital wall, it articulates from front to back with the nasal-bone, the FPM, lacrimal bone , LP to its posterior articulation with the sphenoid at the lesser-wing & anterior part of body.[15]

The ethmoid bone is a cuboidal structure that forms orbit's lateral, superior, and inferior margins, as well as ACF and nasal cavities. From folding of cartilaginous olfactory capsule, it begins to formation at around 25 to 28 weeks of pregnancy. The ethmoid sinuses present right from birth.[42] It is made up of a horizontal plate called the CP and a vertical plate called the perpendicular plate in

middle. The posterior section of the septum is formed by the perpendicular plate. (Fig-1 A & B).

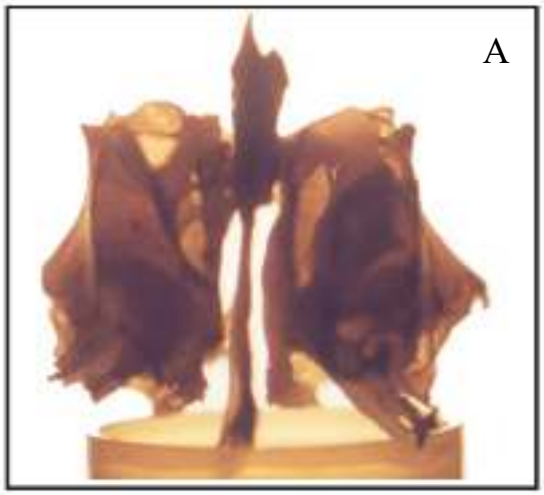


Fig-1A[12]:Ethmoid Bone (coronal view)

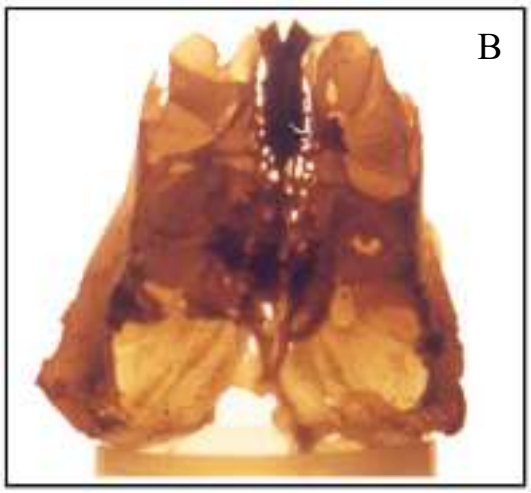


Fig-1B[12]:Ethmoid Bone (Axial view)

The CP fits into the frontal bone and divides the nose from ACF, specifically- gyrus rectus and olfactory bulb. It is pierced by many foramina , which transmit olfactory nerves and AEA and posterior ethmoidal arteries . On upper surface, of CP in midline is a projection, which is called the crista galli. The crista galli is occasionally pneumatized. On closer examination, the CP shows a horizontal medial lamella and an oblique or vertical LL. This LL articulates with the frontal bone. Thus, the ethmoid fovea, which is formed medially by LL of the CP, which is a very thin bone, and laterally by frontal bone, which is a larger bone, forms the skull base in this location. The ethmoid fovea formed by frontal bone is 0.5 mm thick, whereas the CP's LL is 0.2 mm thick. The location where AEA pierces dura medially is thinnest in skull base, with thickness of only 0.05 mm. As a result, it is the most susceptible structure in the entire base of the skull. Anatomy of the ethmoid roof has been documented in several cadaveric investigations..[4] Keros created a three-category categorization based on the CP's location with respect to ethmoid roof in his

research, and this categorization has therapeutic implications in ESS. Keros divides length of the LL and the height of the OF into three categories.:

- Type I — 1-3 mm
- Type II — 4-7 mm
- Type III — 8-17 mm

Fovea ethmoidalis - portion of the frontal bone that divides ethmoidal cells from ACF, forming roof of ethmoidal labyrinth. The fovea ethmoidalis connects- LL of the CP, the thinnest bone at ASB.[16,18]

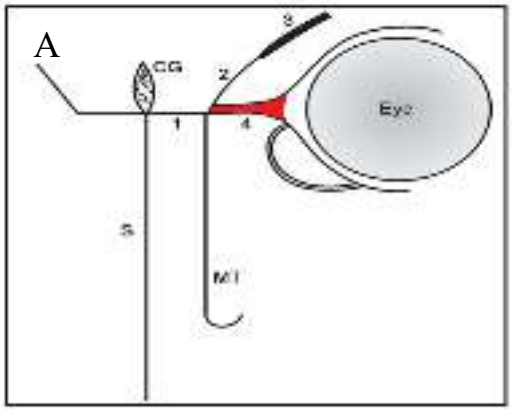


Fig-2A[12]:The CP and ethmoid fovea:
1) Horizontal lamella.
2) LL,
3) Orbital plate of frontal bone.
4) Anterior ethmoidal artery

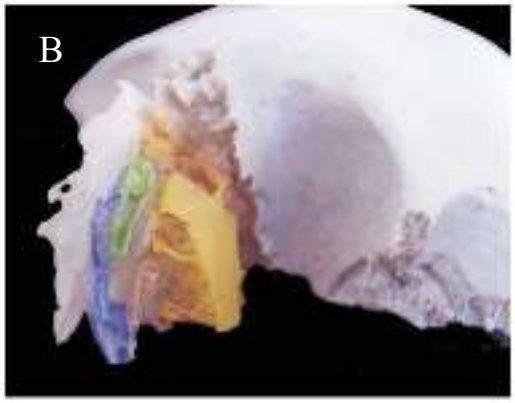


Fig-2B[12]:The basal view of the articulated frontal and ethmoid bones:
1) Perpendicular plate (white),
2) Middle turbinate (blue),
3) Uncinate process (green),
4) Ethmoid air cells (yellow) & LP

Lateral to the perpendicular plate on either side, are two masses of air cells the ethmoidal sinuses (Fig. 2.9). The middle and superior turbinates border them on the medial side, while the paper-thin LP divides ethmoid from orbit on lateral side. Occasionally, above the superior turbinate lies a supreme turbinate . Even though inferior turbinate a distinct bone, middle and superior turbinates are also components of ethmoid bone . The middle turbinate overhangs a space called the

middle meatus. Likewise, superior meatus, region underneath the superior turbinate.

The middle turbinate is a thin bony sheet, which curves in distinctive planes & is comparable to a dried leaf . The frontonasal process of the maxilla and the CP are its most anterior attachments in the sagittal plane. It then rotates laterally to join to LP in coronal plane . The basal or ground lamella is the name for this connection. Its most posterior connection runs along the LP and the palatine bone's perpendicular plate all the way to the roof of the posterior choana . A gently curved bony process lies almost free within the middle meatus partially covering the maxillary sinus opening. Called the uncinate process. It articulates anteriorly with the lacrimal bone and at its posterior end with the inferior turbinate & perpendicular plate of palatine bone. Air cells of the ethmoid are separated into two groups: The AEC's, are located anterior to middle turbinate's ground lamella and open in middle meatus. Superior meatus , or sphenoethmoidal recess, formed by PEC's, which are located behind the ground lamella and open into superior meatus . Depending on the amount of pneumatization of AEC & PEC, ground lamella may be placed anteriorly or posteriorly. The ethmoidal bulla is a large and fairly constant AEC. The ethmoidal cells are incomplete superiorly and posteriorly. They are completed superiorly by frontal bone and posteriorly by the sphenoid bone. (Fig 2 A& B). The ethmoid cells tend to migrate into the surrounding bones to develop variable patterns of pneumatization.

These paths of pneumatization include (see Fig 3 A&B):

- Anterosuperiorly —forms frontal sinus by insinuating into frontal bone.
- Superiorly—above, ethmoidal bulla over the orbit and behind the frontal sinus to form the supraorbital cell.
- Inferolaterally—superior wall of maxillary sinus as Haller cell.
- Posteriorly—above, sphenoid sinus as Onodi cell.
- Anteriorly—into lacrimal bone and FPM as agger nasi cells.
- Superiorly—into frontal recess to form different types of frontalcells.
- Isolated cells may be present within ethmoid infundibulum. These are infundibular cells.

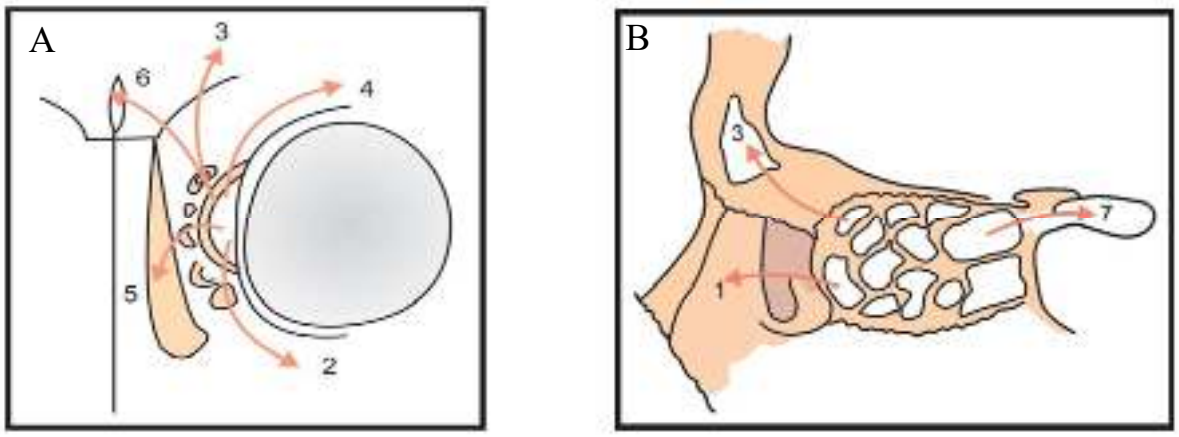


Fig-3. A- coronal view of migration pattern B-Saggital view of migration pattern
Migration patterns of ethmoid air cells into: 1) Lacrimal bone (agger nasi), 2) Inferior to orbit (Haller's cell), 3) Frontal bone (frontal cells), 4)Supra orbital cells, 5) Middle turbinate (concha Bullosa), 6) Crista galli, 7) Above sphenoid (Onodi)

Because CT scan provides precise bone anatomy it acts as "road map" to operating surgeon, CT scan is gold standard examination in all preoperative instances and cannot be substituted by an MRI. After a course of antibiotics, a CT scan is recommended to ensure that acute inflammation is not confused for persistent mucosal illness. Before the CT scan, it's also a good idea to urge the patient to blow

his nose to clear out any loose secretions. The scout image supplied by the radiologist should be studied first. (Fig 4A & B)

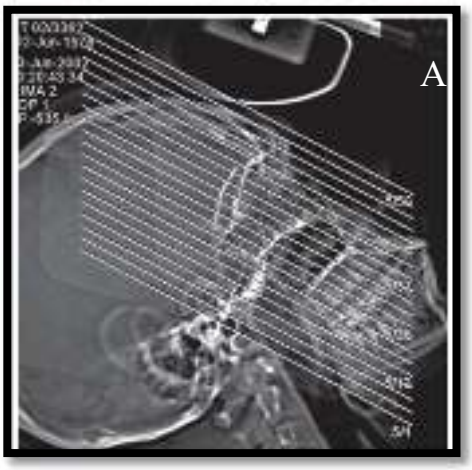


Fig 4A[12]-Scout film

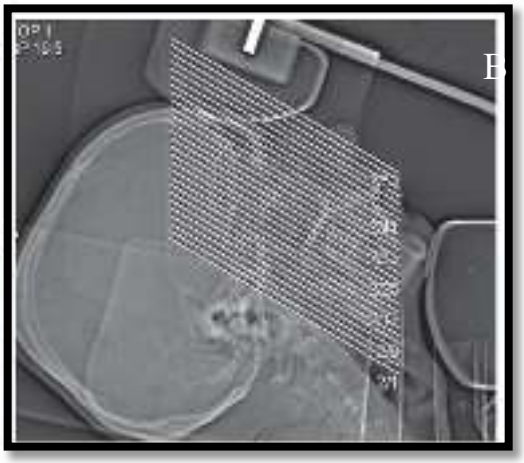


Fig-4B[12]:Scout film

The majority of anatomical characteristics are seen in coronal slices. On axial scans, however, certain structures, such as pterygopalatine fossa, Rosenmueller fossa, and the optic nerve, are more visible. A sagittal reconstruction allows us to examine the anatomy of the lateral nasal wall, which is particularly valuable for studying the frontal recess. In coronal sections, patients with dental fillings have a lot of artefacts. Axial films and coronal reconstructions can be obtained in such instances. Bony and soft tissue windows of 3 mm sections taken anterior to posterior in the coronal plane would be included in a every PNS examination. (Fig 4 A&B) However, in some circumstances, such as optic nerve damage or CSF rhinorrhea, 1 mm sections are required for proper examination. The coronal sections are read from anterior to posterior, whereas the axial sections are read from inferior to superior.

The identification and differential diagnosis of ASB diseases will be aided by comprehensive grasp of anatomy of ASB & its associated soft tissue components. While certain disorders of ASB are radiologically pathognomonic, many are not; as a

result, a precise depiction of lesion, including the size & association of key structures, is critical for effective open and endoscopic surgical planning.

CT imaging is a prerequisite in planning of ESS and open surgical procedure for ASB abnormality. As a result, to avoid potential complications from functional ESS, the height of the OF, defined by the height of the LL, is critical to highlight.[2]

Normal structures to be identified on the CT before planning ESS include the following (Fig 5)[1]:

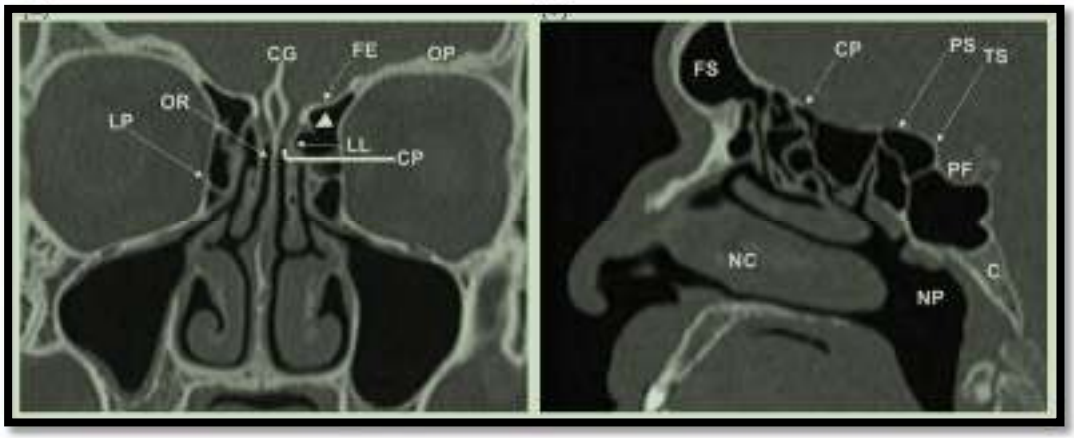


Fig-5[1] : Normal anatomical landmarks on CT PNS

AEA enters the OF through the LL (arrowhead). Ethmoid labyrinth's fovea ethmoidalis /ceiling is connected to frontal bone's orbital plate (OP). Among the perpendicular plate of the nasal septum and the vertical insertion of the middle turbinate lies the olfactory niche or recess (OR). Relationship between ASB, nasal cavity (NC), PNS, orbits, middle skull base, and nasopharynx (NP) can be appreciated.

To minimise major iatrogenic problems during an ESS operation, the surgeon must do a comprehensive pre-operative CT scan examination. Link between cribriform area and medial ethmoid roof may be established via CT imaging. As a

result, Kero's categorization aids in prevention of iatrogenic harm to the cribriform area and ethmoid roof. [2.]

Preoperatively and intraoperatively, precise identification of anatomical landmarks of PNS, particularly of OF and ASB, provides knowledge of individual anatomy & prevents significant bleeding (injury of the anterior ethmoid artery) or injury to ASB (LL of the OF) during the operating procedure. [6]

The skull base and the AEA are two important anatomical features to recognise and preserve in order to avoid difficulties. CSF leak, pneumocephalus , meningitis and brain damage are all possible outcomes of skull base injury. While Keros described a widely adopted categorization of skull base height to recognise individuals at higher risk of iatrogenic damage due to a longer LL prone to injury during ethmoid surgeries , likewise, AEA is a vital component within the ethmoid cavity that, if damaged, can cause considerable blood loss and/or orbital haemorrhage , as well as vision loss.[7]

Using standard CT imaging, skull base height can be used to estimate abnormal AEA location. A higher Keros classification increases the likelihood of an AEA variant in a patient, as well as the AEA being farther away from the skull base. The inexperienced surgeon can do safe ESS by understanding this link.[7]

The AEA - classed as Grade I when it is detected lodged in the skull base,

Grade II when it runs under ASB and appears as protrusion at skull base.

Grade III is the AEA, which flows freely at the base of skull.

Extensive anatomical understanding of the relevant anatomy is essential to minimise potential complications during endoscopic sinus treatments.[1] (Fig-6)

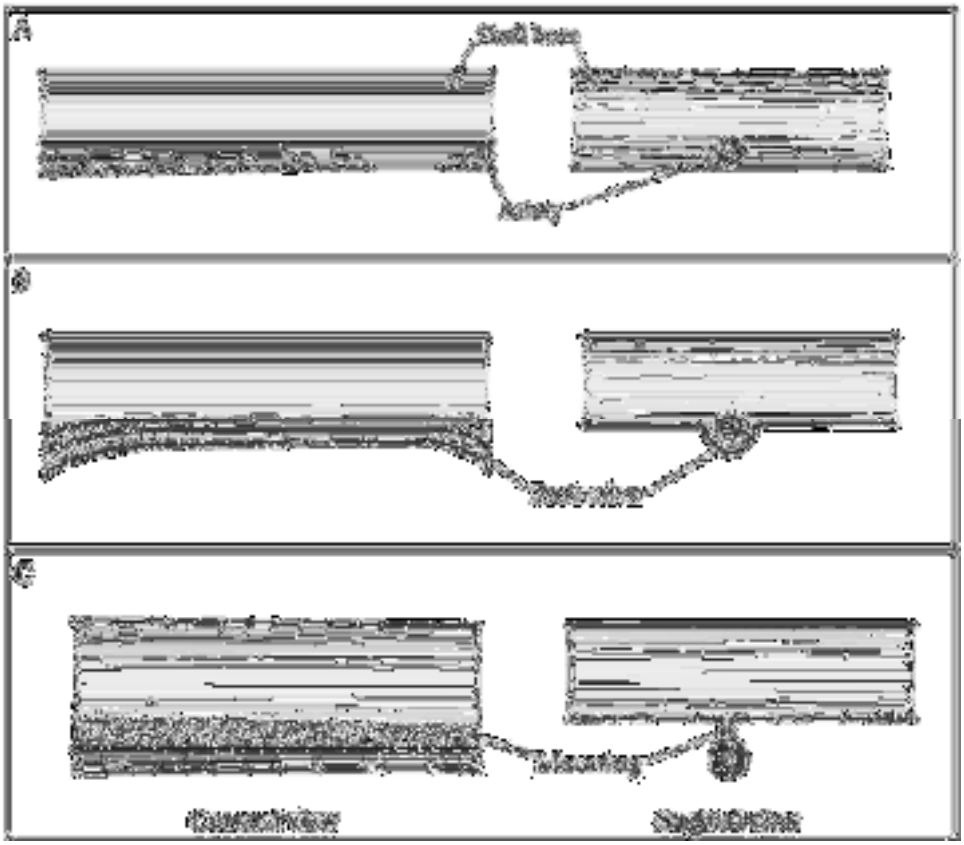


Fig 6[1]-The variable position of AEA in skull base in coronal view and corresponding sagittal view.
a AEA is within skull base. **b** AEA courses at the level of skull base producing bony protrusion. **c** AEA courses freely in the ethmoid sinus within a bony AEC and is connected to skull base by a thin bony mesentery

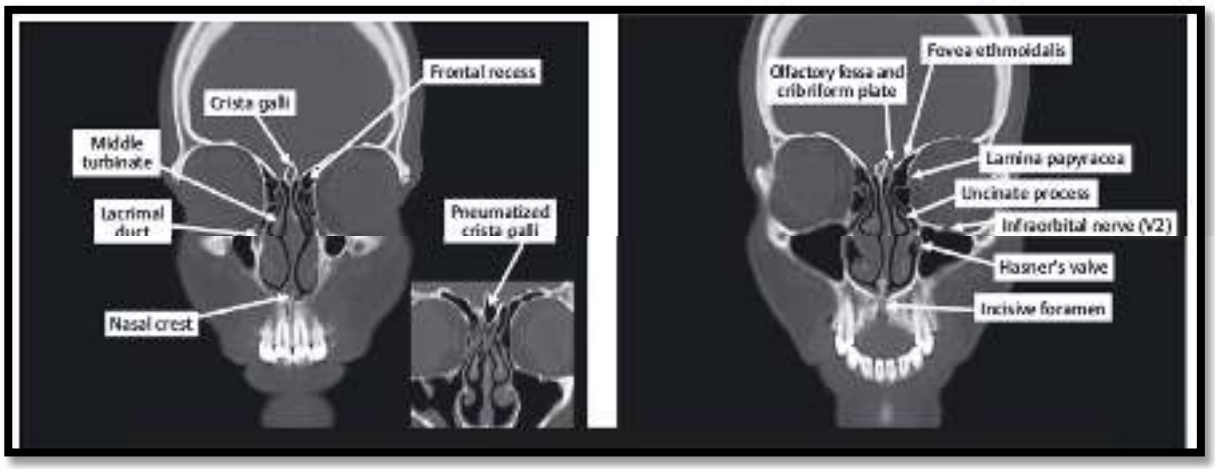


Fig 7[13]: CT PNS (coronal cuts)- various landmarks of para-nasal sinuses & ASB

Although most variations of normal sinus structure have little to no link with rhinosinusitis, they can be crucial for surgical planning and safety. Anatomic risk factors for a CSF leak, such as a steep skull base , FE asymmetry, or a deep OS , may be shown by a comprehensive CT evaluation. Safe sinonasal dissection can be guided by an awareness of the linkages or proximity of essential anatomic components.

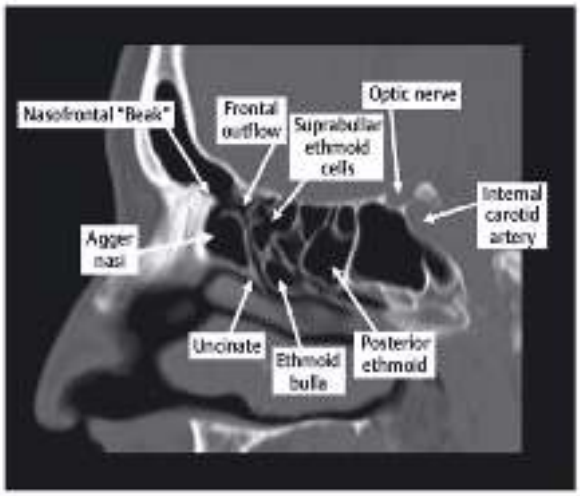


Fig 8A[13]: CT PNS (axial cuts) showing various landmarks of the para-nasal sinuses and ASB

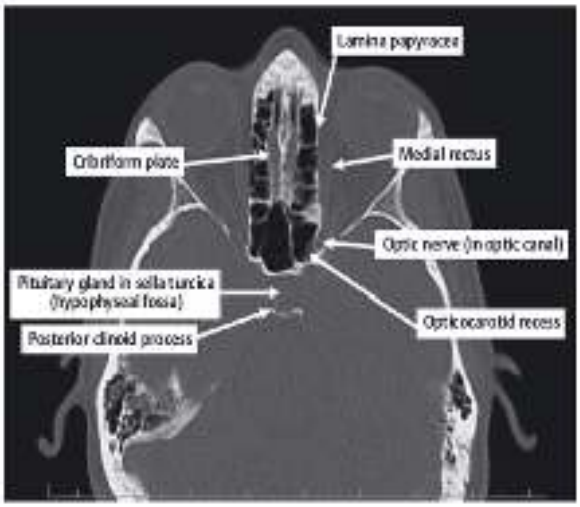


Fig 8B[13]: CT PNS (saggital cut) showing various landmarks of the para-nasal sinuses and ASB

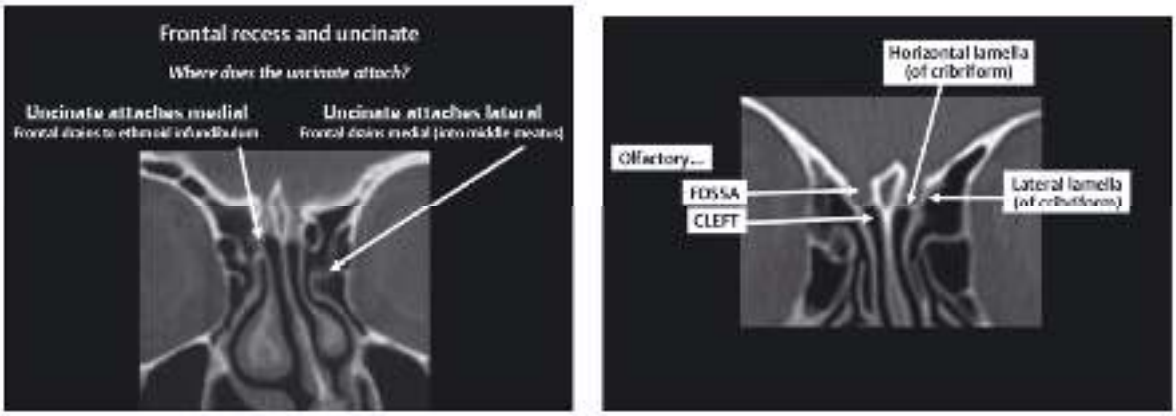


Fig 8C[13]: CT PNS (coronal cut) showing the OF and attachment of the uncinate

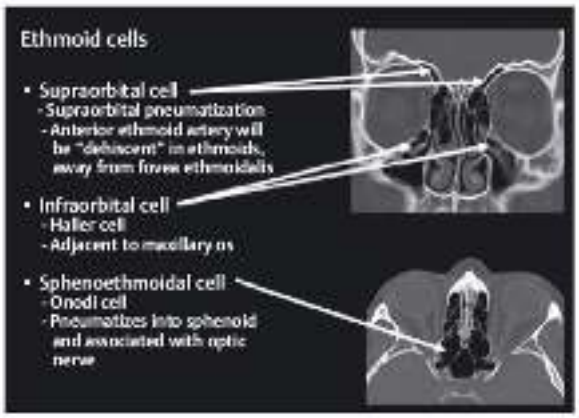


Fig 8D[13]: CT PNS (Coronal cut & Axial cut) showing ethmoid air cells

Sarmad alazzawi et al, showed that keros type II has a higher prevalence in indian males.[3] similarly a study done by Andrzej Skorek also found a higher prevalence of Keros type II in their study. [6]

According to a research by Baharudin Abdullah et al, the presence of SOEC & the length of the LL indicate position of the AEA at the skull base in this study. They also discovered, Asians had a shorter gap between the front ethmoidal artery and the nasal floor. Variations in the anterior ethmoidal artery should be acknowledged in various groups to avoid issues. [8]

CT scans are also helpful in identifying the location of AEA preoperatively, The orbit, the ethmoid labyrinth, and the ACF of the skull are all crossed by AEA. The OF is accessed by LL of the CP, which runs through so-called AES, most fragile part of ASB. The bone is incredibly thin at this time, making nasal endoscopic surgery a high-risk procedure. Location of the AEA relative to the ethmoidal ceiling varies greatly as it travels through the ethmoid labyrinth; as a result, the artery is prone to damage during surgical procedures. (Fig 9A-D).[13]

In its path through the OF, this artery irrigates the AEC & frontal sinus & gives birth to the meningeal veins, descends to the nasal fossa to irrigate the anterior 1/3rd of nasal septum lateral wall of the nose. [13]

AEA-an anatomical landmark whose position is critical for identifying difficult to reach tissues (such as frontal sinus) & defining surgical superior limits (skull base). Furthermore, by seeing this artery, it is feasible to identify and treat the reasons of severe epistaxis.[13]

The AEC is in direct touch with the skull base , according to Kainz and Stammmberger[11], especially when the ethmoid sinus has a low lying roof. In most cases, a mesentery links the canal to the roof of the ethmoid sinus, AEA & roof may be separated up to 5 mm. In endoscopic dissections, Becker[16] discovered a similar anatomical condition. In contrast to previous investigations, Moon et al.[11] discovered in anatomical specimens that the AEA ran freely through the anterior ethmoidal cells in only 11% of cases and made direct contact with the skull base in 85.7 percent cases.[13]

Fig 9[8] A- AEC- in its course through the AE cells (arrows).

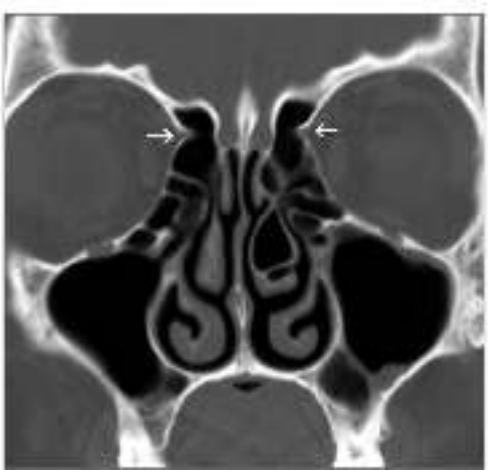


Fig 9[8] B- AES- bony sulcus (tip of arrows) on lateral walls of the OF, corresponding to AES

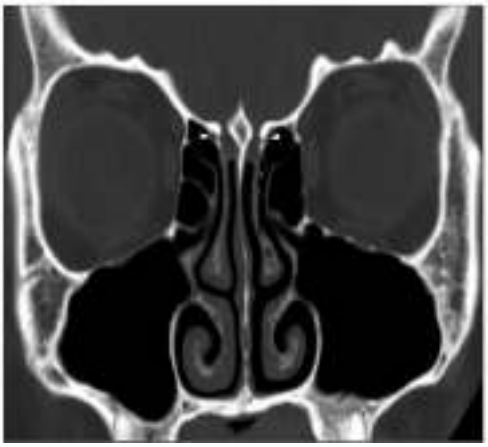


Fig 9[8] C-AEF - represented by a bony notch (arrows) on the medial wall of the orbits .

Fig 9[8] D- Supraorbitary pneumatization - ample bilateral supraorbitary pneumatization (arrows)

Although several factors influence the placement of the AEA in relation to the EB and FB, measurements acquired in this study contribute to anatomical knowledge that might be used as a criterion in frontal and ethmoidal sinus surgery Higher the scientific understanding of relationship between AEA and its neighbouring tissues, the less likely it is to injure a patient inadvertently while avoiding hematoma and CSF fistula[15]

Therefore in this study, our aim is to identify any significant anatomical variations on the CT scans preoperatively to prevent inadvertent complications intraoperatively.

MATERIALS AND METHODS

STUDY DESIGN: Observational study.

STUDY PERIOD: 1 year

STUDY POPULATION: All CT- PNS scans done in KLES Dr.Prabhakar Kore Hospital & MRC , Belgaum during the study period.

SAMPLE SIZE: 40

The minimum sample size formula based on prevalence rate is

$$n = \frac{z_\alpha{}^2 P(1-P)}{d^2}$$

P denotes the prevalence percentage and d denotes the percent expected difference in prevalence.

The significance level is related to z. For a 5% threshold of significance, z = 1.96 is used.

Ref: Skorek, A., Tretiakow, D., Szmuda, T. and Przewozny, T., 2016. Is the Keros classification alone enough to identify patients with the 'dangerous ethmoid'? An anatomical study. Acta Oto-Laryngologica, 137(2), pp.196-201.

With P = 75.83% and d = 20% of P = 15.17%, the sample size is 31.

The sample size will be increased to 40 to get confirmative results.

SAMPLING PROCEDURE: All the CT- PNS scans done in Dr. Prabhakar Kore Hospital & MRC, Belgaum, India for 2 years during the period January 2019 – December 2020 were obtained.

INCLUSION CRITERIA:

- All patients that underwent CT - PNS in Department of ENT&HNS in KLE Dr. Prabhakar Kore hospital & MRC.
- All patients with possible or evident sinonasal diseases.

EXCLUSION CRITERIA:

CT scans of

- Patients who underwent prior sinonasal surgery,
- Patients with fungal sinusitis
- Patients with malignancy of nose and PNS
- Patient with craniofacial trauma
- Patients with immotile cilia syndrome, kartageners syndrome, down syndrome, and cystic fibrosis who have impaired ciliary motility.

METHODOLOGY:

- PNS CT scans will be evaluated.
- Each side was evaluated for the presence of anatomical variations. In radiological detection one of these variations (Septal deviation, Concha Bullosa, attachment of the uncinate process, Medialised uncinate process, pneumatised crista galli, supraorbital ethmoidal pneumatization, agger nasi, anterior-posterior length of CP) at CT scans will be regarded as anatomic variation.

Structures Evaluated:

- Degree of nasal septal deviation (*Image 1*)
- The depth of skull base was measured along the LL between the CP and the FE & classified as keros. Identification of AEA within skull base or separated from skull base, vertical distance from the midpoint of the intranasal anterior ethmoid artery to the skull base was measured. (*Image 5 & Image 6*)
- Distance between AEF and AES from NF and IOF (*Image 3 & Image 4*)
- Infraorbital nerve point (IOF)
- Medial ethmoid roof point (MERP)
- CP point
- The interval from horizontal margin of the OF to the orbital part of the ethmoid bone .
- The angle of OF- from LL to the CP. (*Image- 4)*
- Anatomical variations in the LP, in case of absence, variation will be noted. (*Image 7*)
- Bony cover over the anterior ethmoidal artery
- The sinusitis seen on CT scan will be classified by Lund and Mackay's classification (Lund and Mackay scoring system)[43]
- Any other abnormality if observed will be recorded.

Sinus	Right sinus	Left sinus
Frontal	0–2	0–2
Anterior ethmoids	0–2	0–2
Posterior ethmoids	0–2	0–2
Maxillary	0–2	0–2
Sphenoid	0–2	0–2
Ostiomeatal complex	0 or 2	0 or 2

For the sinuses: 0 = no inflammation; 1 = partial inflammation; 2 = 100% inflammation.
For the ostiomeatal complex: 0 = not occluded; 2 = occluded.
Maximum total score: 24.

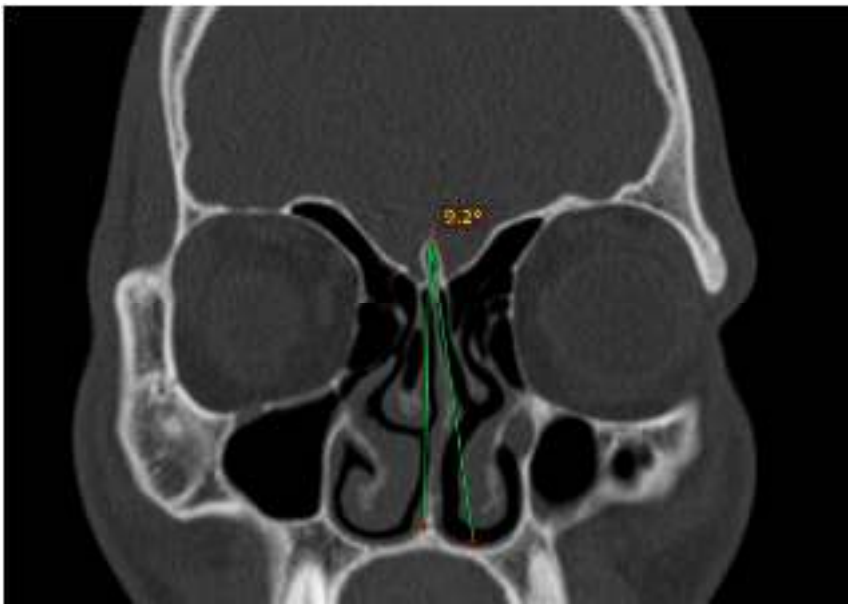


Image -1 **Measurement of the nasal septal deviation (Left Deviation of septum by 9.2^0)**

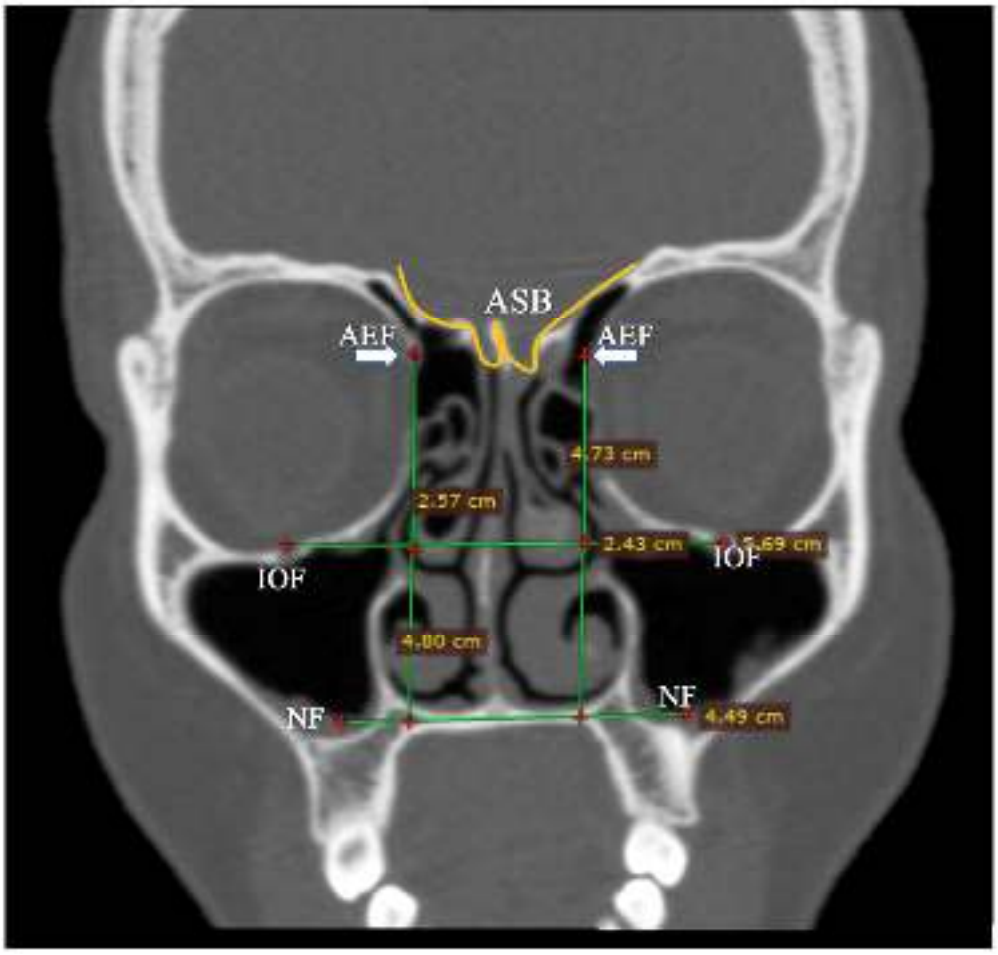


Image- 2 **Measurement of the anterior ethmoidal foramen from the nasal floor and infra orbital foramen.**

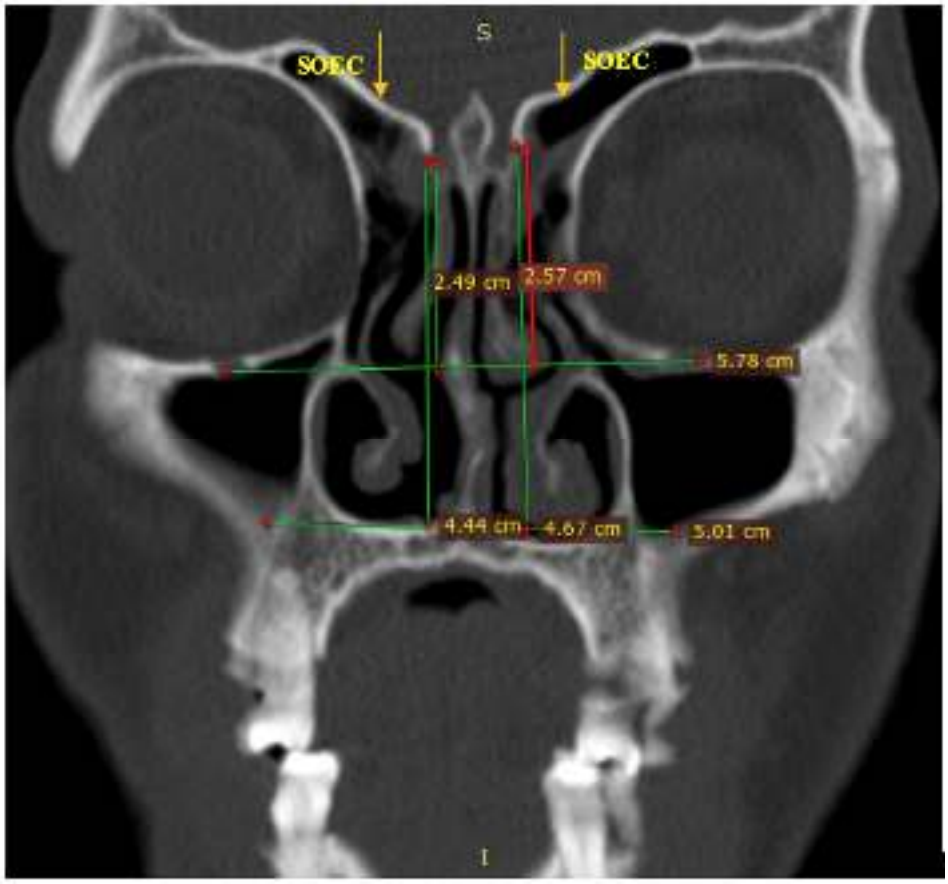


Image- 3 **Measurement of Anterior ethmoidal sulcus from the nasal floor and the Infra orbital foramen. SOEC (yellow arrows)**

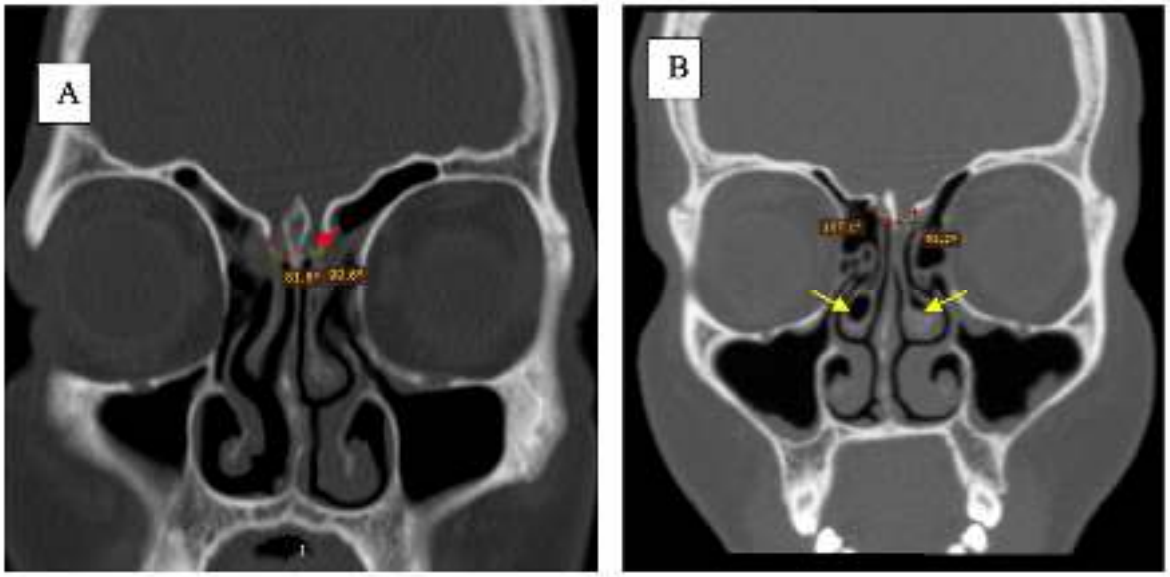


Image- 4 **Measurement of angle between the lateral lamella and cribriform plate (A & B)**

A- Pneumatized Crista galli show (red arrow)

B- Bilateral Concha bullosa (yellow arrows)

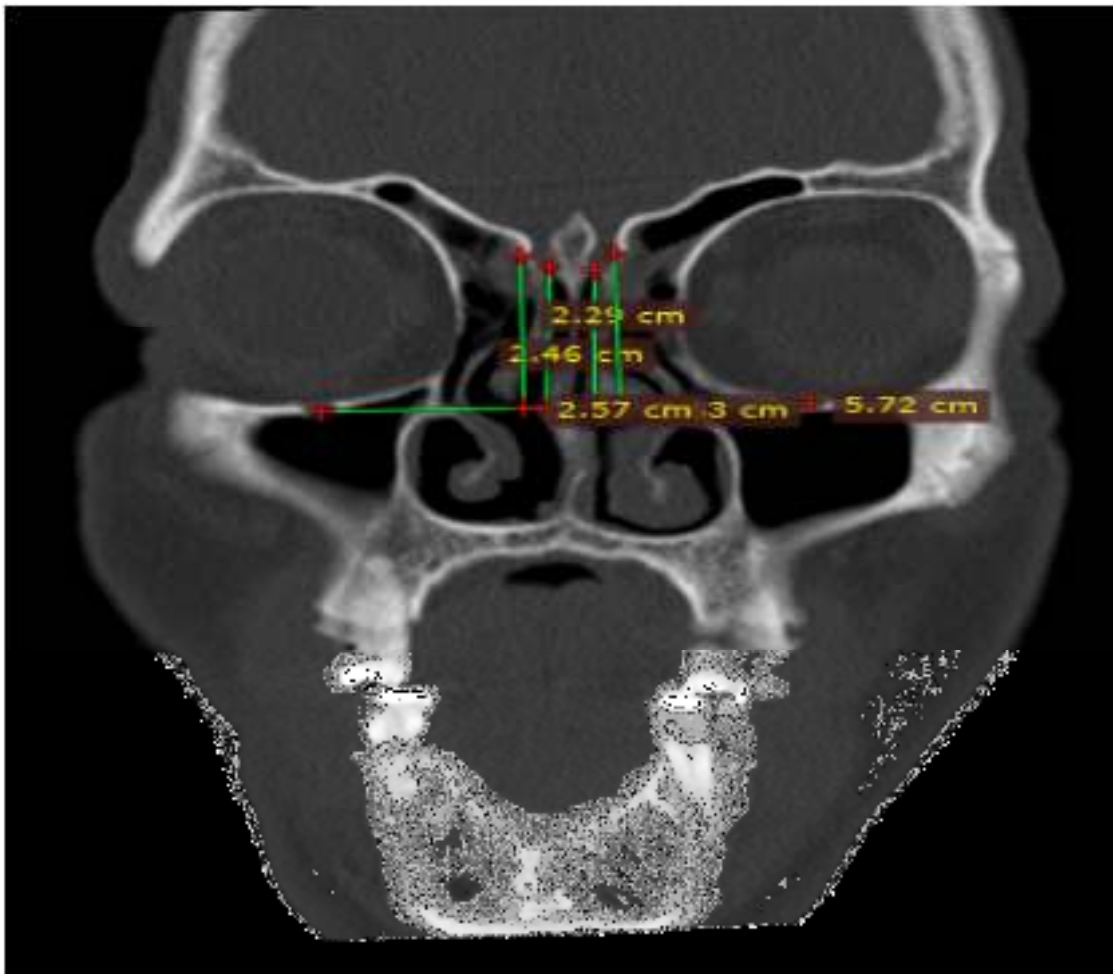


Image-5 **Measurement of the olfactory fossa depth- length of lateral lamella measured and subtracted from the length of the cribriform plate**

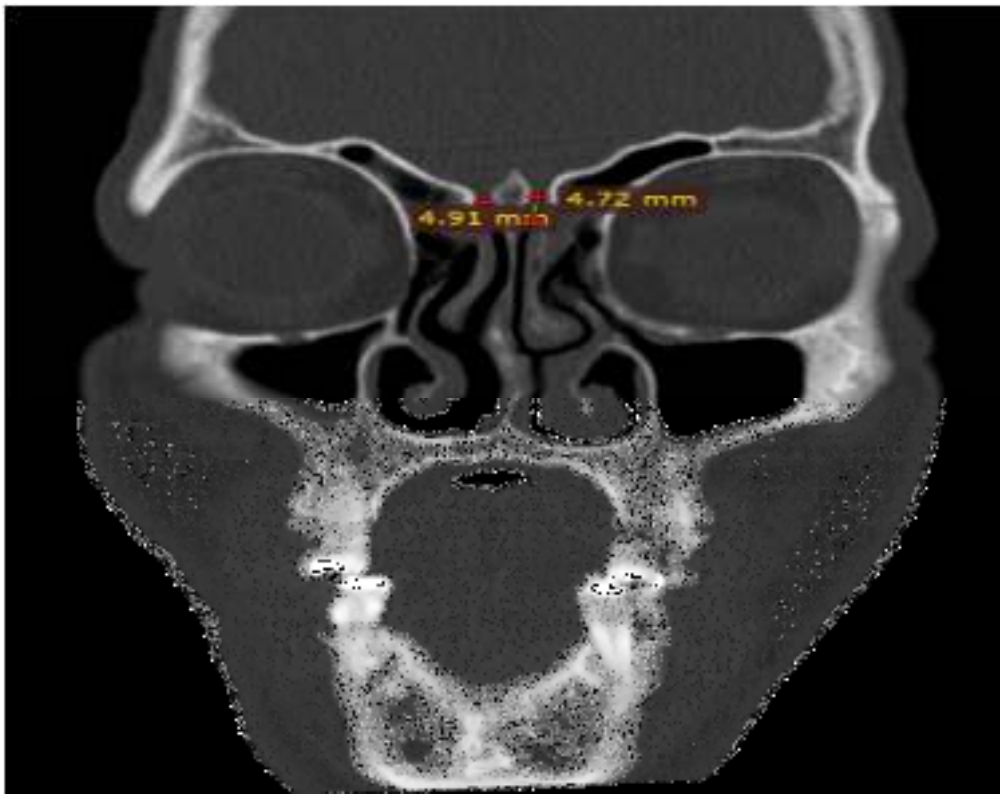


Image- 6 **Measurement of the height of olfactory fossa**

Image-7 **Length of lamina papyracea**

STATISTICAL ANALYSIS:

Since the study is an observational study the plan of analysis was as follows.

For the continuous quantitative variables mean and standard deviation were calculated. For the purpose of comparison if the data is divided into two groups with respect to certain qualitative characteristic, the continuous variables were compared using suitable tools of statistics like student's unpaired t test . The pre and post treatment measures will be compared using student's paired t test

Discrete variables are represented by median.

Rates, ratios, and percentages are used to convey categorical data . The Chi-square test, test of proportion, & Fisher's exact test were used to examine relationship between result, clinical & demographic factors.

For discrete variables nonparametric tests was used.

Apart from the above suitable tools like ANOVA, correlation, regression etc., will be used according to the need.

Suitable graphs are used to depict the comparison.

For all the tests the value of p less than 5% (0.05) will be considered significant.

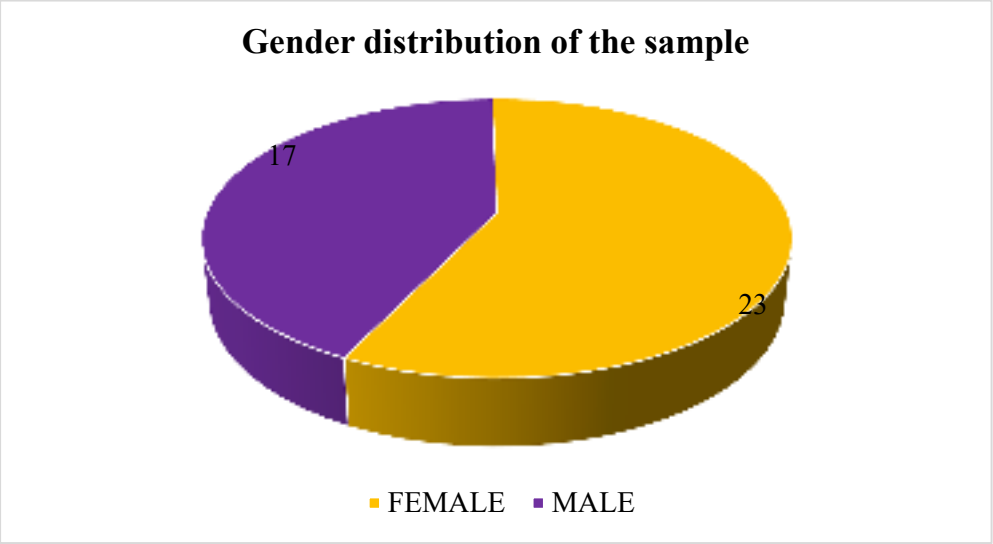
ETHICAL CONSIDERATIONS:

Ethical clearance for the study was obtained from the JNMC Institutional Ethics Committee on Human Subjects Research and the reference number was **MDC/DOME/ 438**.

RESULTS

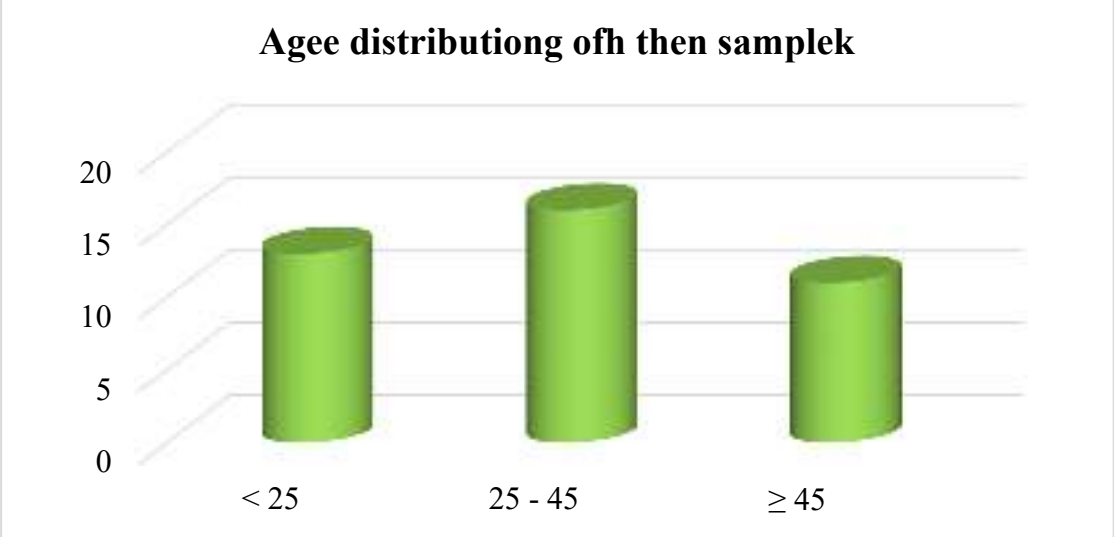
1- GENDER AND AGE DISTRIBUTION OF THE SAMPLE

Graph 1a- Male to female distribution of the sample



In my study 40 CT scans 23 females (57.5%) & 17 males (42.5%)

Graph 1b- Age distribution of the sample



The study includes 3 age groups age <25 years - 13 (32.50%)

Age 25-45 years -16 (40%)

Age >45 years -11 (27.5%)

2- DEVIATED NASAL SEPTUM

Table 1a- Right & Left distribution of patients with Deviated nasal septum

In the following table p-value is calculated using student's unpaired t test

RIGHT				LEFT				
MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
6.79	2.59	2	10.8	7.84	3.61	3	16	0.2925

The mean of Deviated nasal septum to right was 6.79+/- 2.59 to the left 7.84 +/- 3.61 with p Value 0.2925 (NS)

TABLE 1b- Age distribution of patients with deviated nasal septum

In the following tables p value is calculated using one way analysis of variance (ANOVA)

	AGE												
	< 25				25 - 45				≥ 45				
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
RIGHT	6.9	1.72	4.3	9	7.05	2.76	3.7	10.8	6.15	3.36	2	10	0.7942
LEFT	7.68	4.65	3.2	16	7.18	3.62	3	10.4	8.56	2.76	4.9	11.9	0.4094

In age <25 years- mean on right 6.90 +/- 1.72 & left 7.68 +/- 4.65

Age 25-45 years- mean on right 7.05 +/- 2.76 & left 7.18 +/- 3.62

Age >45 years- mean on right 6.15 +/- 3.36 & left 8.56 +/-2.76

Right p Value 0.7942 (NS) and Left p Value 0.4094 (NS)

TABLE 1c- Gender distribution

In the following table p value is calculated using student unpaired t Test

		FEMALE (n = 23)				MALE (n = 17)				
		MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
	AGE	36.04	14.81	18	65	36.29	14.98	18	65	0.9583
DEVIATED NASAL SEPTUM	**RIGHT**	7.26	2.64	2	10.8	5.6	2.19	2	7.9	0.1557
SEPTUM	**LEFT**	8.6	2.46	6	11.9	7.46	4.13	3	16	0.5832

In females right deviation mean was 7.26 +/- 2.64 & left 8.60 +/- 2.46

In males right deviation mean was 5.60 +/-2.19 & left 7.46 +/- 4.13

Right p Value 0.1557 (NS) and left p Value 0.5832 (NS)

3-DISTANCE OF THE AEF & SULCUS FROM THE NASAL FLOOR AND INFERIOR ORBITAL FOSSA RESPECTIVELY

TABLE 2a- Comparison between right and left sides

In the following table p value is calculated using student's unpaired t test

	RIGHT				LEFT				
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
AEF (NF)	4.49	0.28	4.01	5.1	4.51	0.29	4.07	5.16	0.7638
ANTERIOR ETHMOIDAL FORMEN (IOF)	2.41	0.20	2.06	2.85	2.45	0.25	2.1	3.01	0.4014
AES (IOF)	3.43	1.08	2.16	5.07	3.45	1.05	2.14	5.05	0.9302

The mean of AEF from the NF on the right was 4.49 =/- 0.28 to the left 4.51 +/- 0.29 with p Value 0.7638 (NS)

The mean of AEF from the IOF on the right was 2.41=/-0.20 and on the left 2.45 +/- 0.25 with a p Value 0.4014

The mean of AES from the IOF on the right was 3.43 =/-1.008 and on left 3.45=/-2.14 with p Value of 0.9302

TABLE 2b- Gender Comparison

In the following table p Value was calculated using student's unpaired t Test in comparison between females and males

		FEMALE (n = 23)				MALE (n = 17)				
		MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE
	AGE	36.04	14.81	18	65	36.29	14.98	18	65	0.9583
AEF (NF)	RIGHT	4.40	0.23	4.01	4.9	4.63	0.29	4.1	5.1	0.0080
	LEFT	4.40	0.24	4.07	4.98	4.67	0.27	4.23	5.16	0.0022
ANTERIOR ETHMOIDAL FORMEN (IOF)	RIGHT	2.34	0.17	2.06	2.78	2.51	0.19	2.12	2.85	0.0064
	LEFT	2.39	0.24	2.1	2.9	2.54	0.25	2.1	3.01	0.0497
AES (IOF)	RIGHT	3.32	1.07	2.16	5.07	3.58	1.11	2.24	5.04	0.4711
	LEFT	3.31	1.04	2.14	5.05	3.65	1.07	2.19	5.04	0.3117

In AEF measured from the NF-

Females: mean right 4.40 +/-0.23 & left 4.40 +/- 0.24

Males: Mean right 4.63 +/- 0.29 & left 4.67 +/- 0.27

Right p Value 0.0080 (NS) and left p Value 0.0022 (NS)

In AEF measured from the IOF-

Females: mean right 2.34 +/-0.17 & left 2.39 +/- 0.24

Males: Mean right 2.51 +/- 0.19 & left 2.54 +/- 0.25

Right p Value 0.0064 (NS) and left p Value 0.0497 (NS)

In AES measured from the IOF-

Females: Mean right 3.32 +/- 1.07 & left 3.31 +/- 1.04

Males: Mean right 3.58 +/- 1.11 & left 3.65 +/- 1.07

Right p Value 0.4711 (NS) and left p Value 0.3117 (NS)

TABLE 2c- Comparison between age groups

In the following tables p value is calculated using one way analysis of variance (ANOVA)

		AGE												
		< 25				25 - 45				≥ 45				
		MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE
AEF (NF)	RIGHT	4.54	0.26	4.2	5.06	4.51	0.29	4.01	5.1	4.42	0.3	4.1	4.93	0.5928
	LEFT	4.6	0.33	4.17	5.16	4.48	0.27	4.07	5.1	4.46	0.26	4.08	4.91	0.4415
ANTERIOR ETHMOIDAL FORMEN (IOF)	RIGHT	2.38	0.18	2.13	2.7	2.41	0.19	2.08	2.78	2.44	0.23	2.06	2.85	0.7858
	LEFT	2.42	0.25	2.1	2.9	2.44	0.24	2.11	2.89	2.51	0.27	2.1	3.01	0.6286
AES (IOF)	RIGHT	3.03	1.05	2.16	4.82	3.73	1.05	2.3	5.04	3.48	1.11	2.22	5.07	0.2211
	LEFT	3.09	1.01	2.14	4.77	3.72	1.04	2.2	5.04	3.51	1.08	2.26	5.05	0.2787

In AEF measured from the NF-

Age <25years: mean right 4.54 +/-0.26 & left 4.60 +/- 0.33

Age 25-45 years: mean right 4.51 +/- 0.29 & left 4.48 +/- 0.27

Age >45 years: mean right 4.42 +/- 0.30 & left 4.46 +/- 0.26

Right p Value 0.5928 (NS) and left p Value 0.4415 (NS)

In AEF measured from the IOF-

Age <25years: mean right 2.38 +/-0.18 & left 2.42 +/- 0.25

Age 25-45 years: mean right 2.41 +/- 0.19 & left 2.44 +/- 0.24

Age >45 years: mean right 2.44 +/- 0.23 & left 2.51 +/- 0.27

Right p Value 0.7858 (NS) and left p Value 0.6286 (NS)

In AES measured from the IOF-

Age <25years: mean right 3.03 +/- 1.05 & left 3.09 +/- 1.01

Age 25-45 years: mean right 3.73 +/- 1.05 & left 3.72 +/- 1.04

Age >45 years: mean right 3.48 +/- 1.11 & left 3.51 +/- 1.08

Right p Value 0.2211 (NS) and left p Value 0.2787 (NS)

TABLE 3- ANGLE BETWEEN LL AND CP

TABLE 3a- Comparison between the two sides

In the following table p value is calculated using student's unpaired t test

RIGHT				**LEFT**				
MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
103.76	20.32	48	128.9	98.31	18.82	59	139.8	0.2167

The mean of angle between later lamella and CP on the right was 103.76 +/- 20.32 on the left was 98.31+/- 18.82 with p Value 0.2167 (NS)

TABLE 3b- Comparison between males and females

In the following tables p value is calculated using student's unpaired t test comparison between females and males

	FEMALE (n = 23)				MALE (n = 17)				
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
AGE	36.04	14.81	18	65	36.29	14.98	18	65	0.9583
RIGHT	103.16	22.43	48	128.9	104.58	17.71	72.6	128	0.8303
LEFT	97.59	19.06	62.7	139.8	99.28	19.02	59	129.7	0.7830

In angle between LL and CP-

Females: Mean right 103.16 +/- 22.43 & left 97.59 +/- 19.06

Males: Mean right 104.58 +/- 17.71 & left 99.28+/- 19.02

Right p Value 0.8303 (NS) and left p Value 0.7830 (NS)

TABLE 3c- Comparison among the age groups

In the following tables p value is calculated using one way analysis of variance (ANOVA)

	AGE												
	< 25				25 - 45				≥ 45				
	MEAN	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**MEAN**	**S.D.**	**MIN**	**MAX**	**p VALUE**
RIGHT	103.15	23.73	48	128	105.49	12.64	76.7	124.7	101.97	26.2	52.8	128.9	0.9039
LEFT	93.22	15.54	59	116.9	102.15	20.8	65	139.8	98.73	19.62	62.7	123	0.4552

In angle between LL & CP-

Age <25years: mean right 103.15 +/- 23.73 & left 93.22+/- 15.54

Age 25-45 years: mean right 105.49 +/- 12.64 & left 102.15 +/- 20.80

Age >45 years: mean right 101.97 +/- 26.20 & left 98.73 +/- 19.62

Right p Value 0.9039 (NS) and left p Value 0.4552 (NS)

2- ANTERIOR 1/3RD OF OLFACTORY

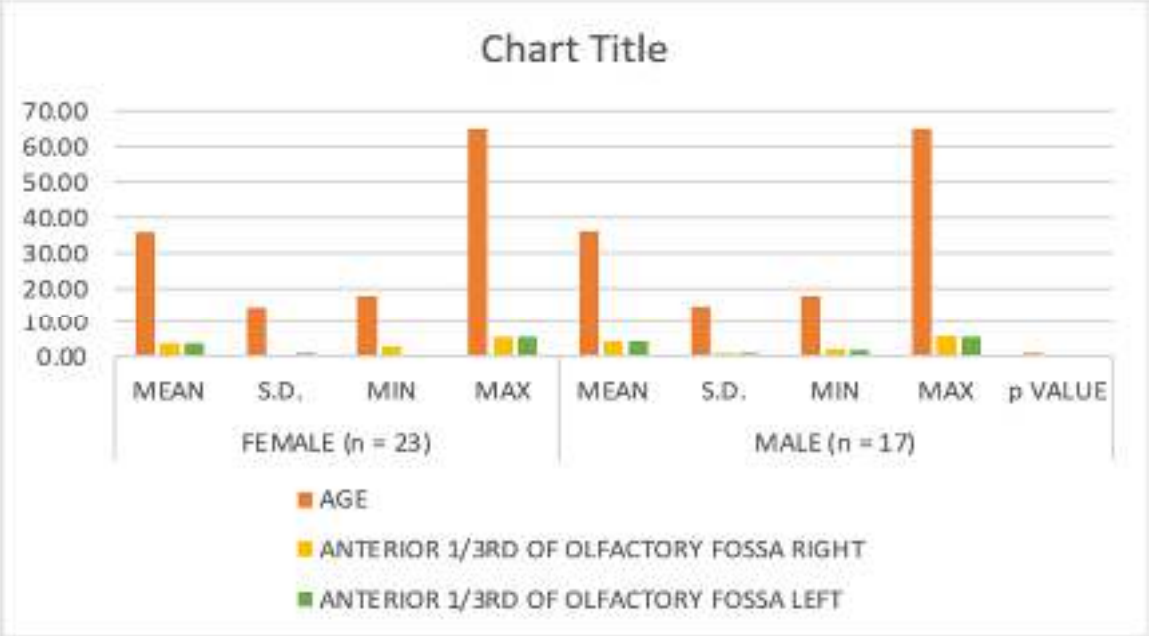
Graph 2a- Comparison between right and left sides

In following graph p value is calculated using student's unpaired t test

The mean of anterior 1/3rd of OF on the right was 3.99mm +/- 0.70 and on left 3.81+/- 0.94 with a p Value of 0.3604 (NS)

Graph 2b- Comparison between male and females

In the following Graph p Value was calculated using student's unpaired t Test in comparison between females and males



In the study of anterior 1/3rd of OF-

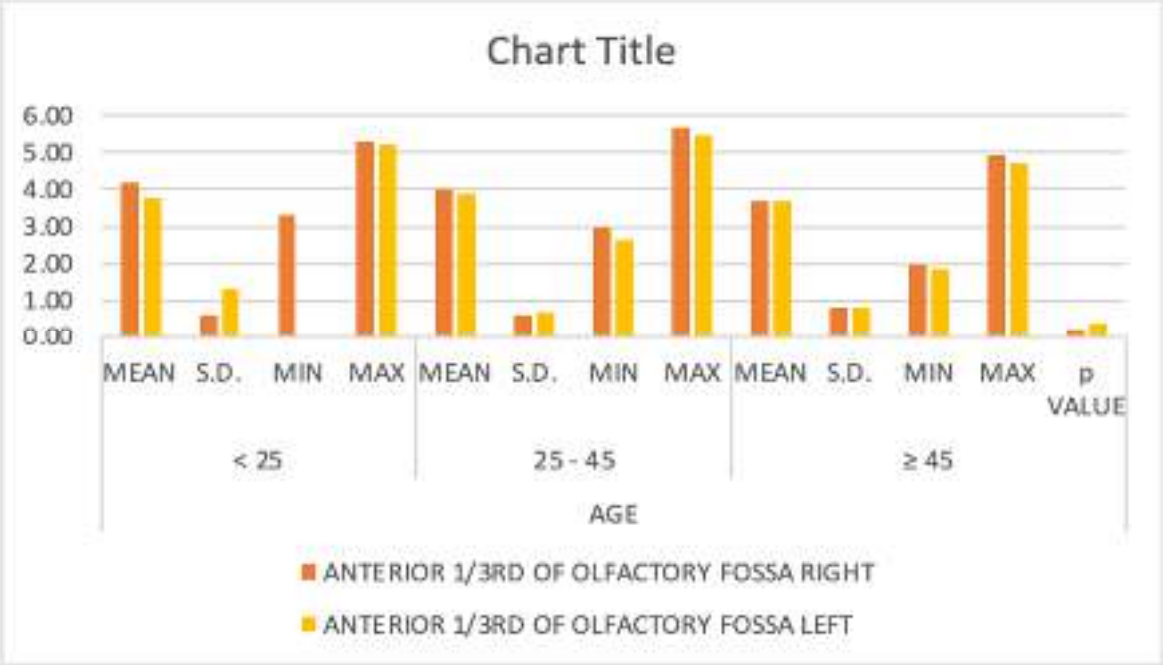
Females: Mean right 3.91 +/- 0.56 & left 3.65 +/- 1.01

Males: Mean right 4.07 +/- 0.87 & left 4.01 +/- 0.84

Right p Value 0.4997 (NS) and left p Value 0.2300 (NS)

Graph 2c- Comparison among three age groups

In the following Graph p value is calculated using one way analysis of variance (ANOVA)



In the study of anterior 1/3rd of OF-

Age <25years: mean right 4.16 +/- 0.64 & left 3.79 +/- 1.33

Age 25-45 years: mean right 4.04 +/- 0.62 & left 3.89 +/- 0.72

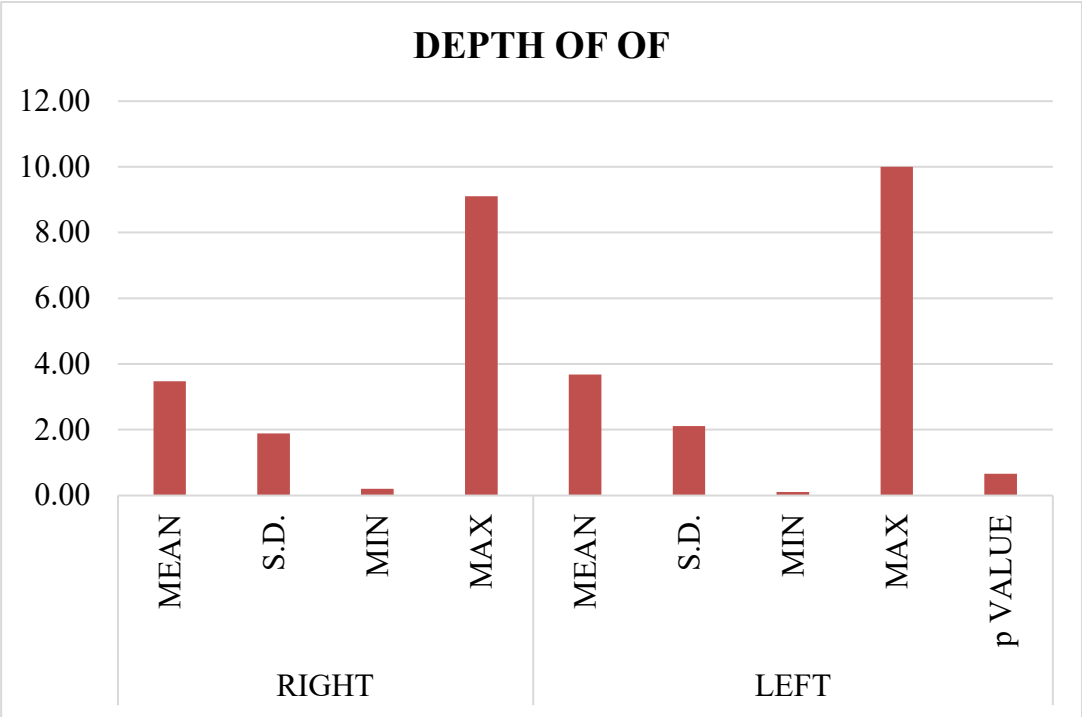
Age >45 years: mean right 3.67 +/- 0.84 & left 3.71 +/- 0.81

Right p Value 0.2119 (NS) and left p Value 0.3640 (NS)

3- HEIGHT OF OF (MERP-LLCP = DEPTH OF OF)

Graph 3a- Comparison between right and left sides

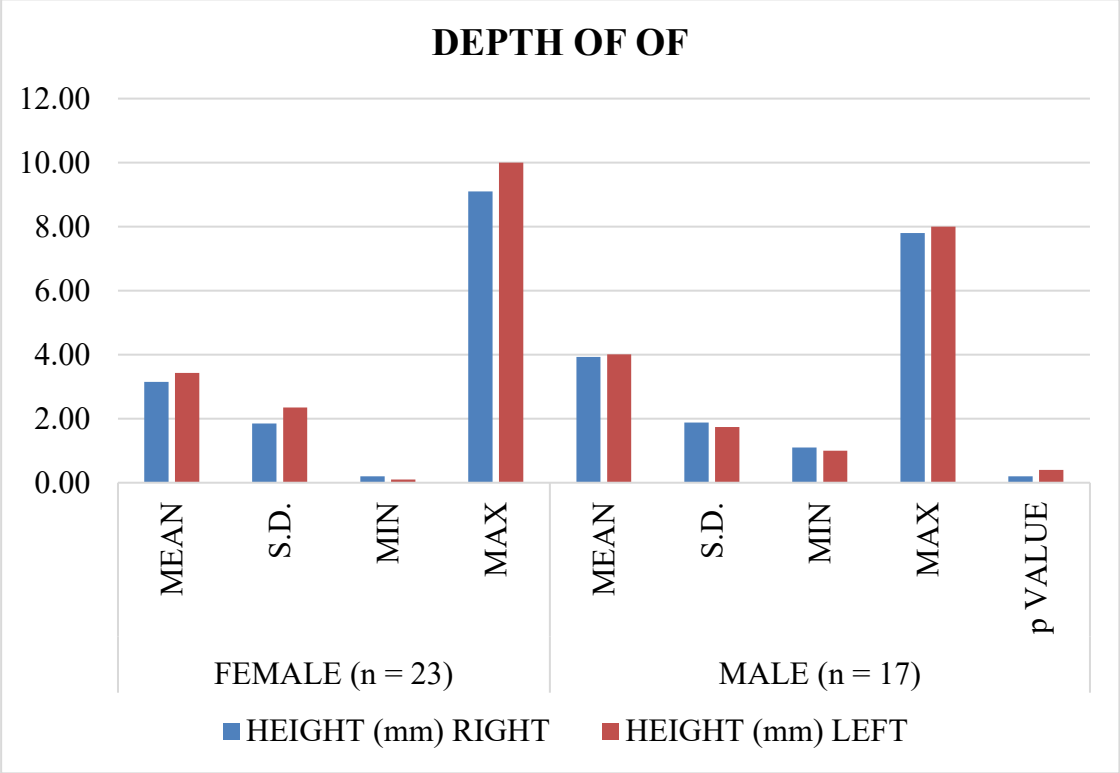
In the following graph p value is calculated using student's unpaired t test



The mean OF depth on right was 3.48mm +/- 1.88 and on left 3.68mm +/- 2.11 with p Value 0.65556 (NS)

Graph 3b- Comparison between females & males

In the following Graph p Value was calculated using student's unpaired t Test in comparison between females and males



In the study of Depth of the OF-

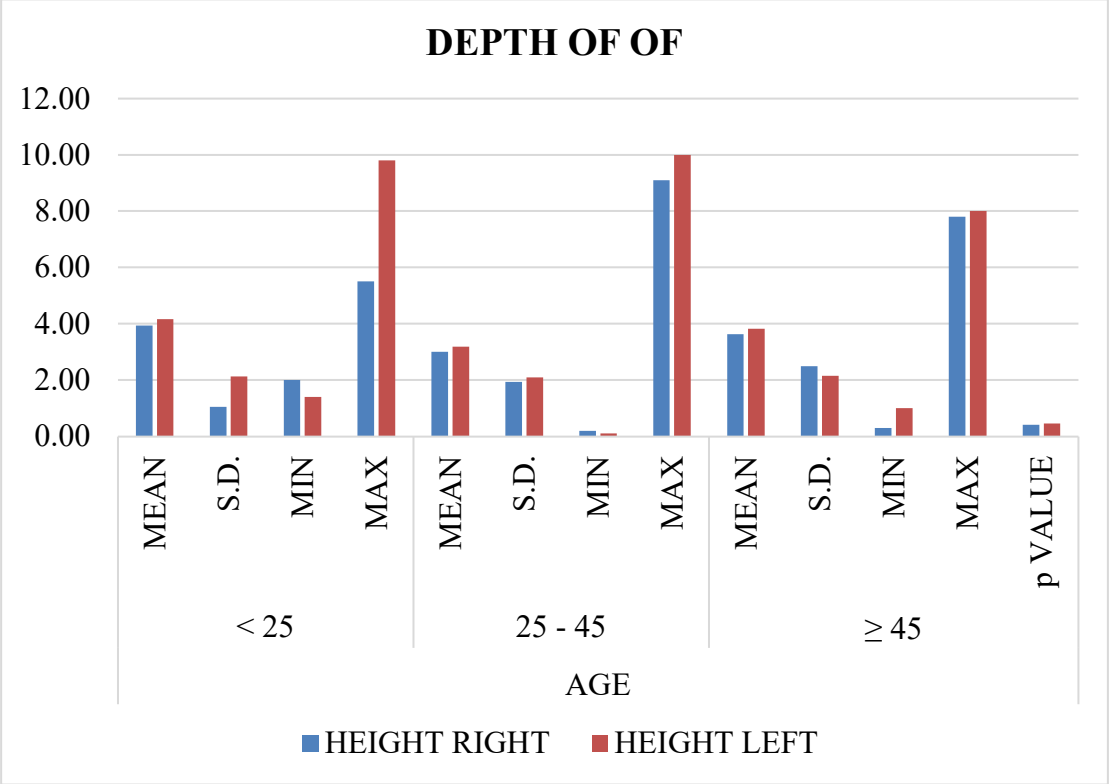
Females: Mean right 3.14 +/- 1.85 & left 3.43 +/- 2.35

Males: Mean right 3.92 +/- 1.88 & left 4.01 +/- 1.74

Right p Value 0.1981 (NS) and left p Value 0.4010 (NS)

Graph 3c- Comparison between age groups

In the following Graph p value is calculated using one way analysis of variance (ANOVA)



In the study of depth of

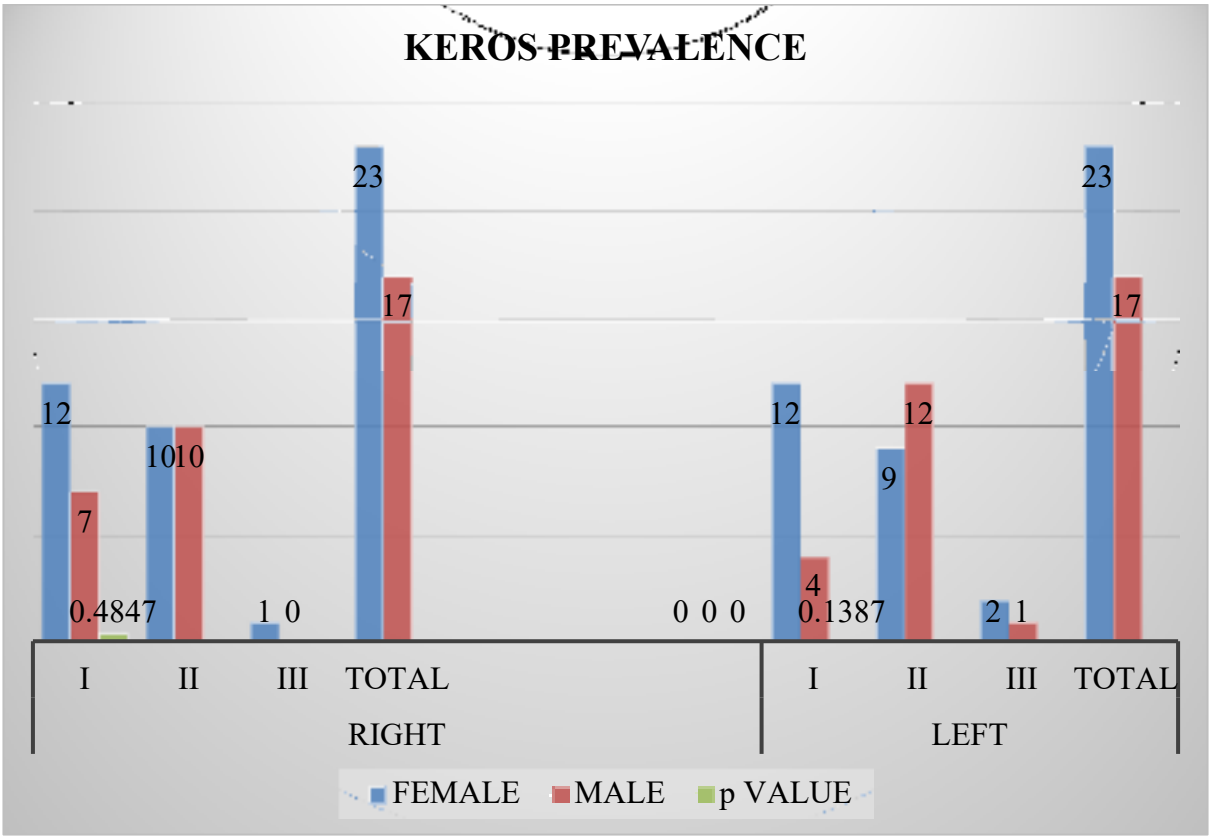
Age <25years: mean right 3.93 +/- 1.05 & left 4.16 +/- 2.13

Age 25-45 years: mean right 3.00 +/- 1.93 & left 3.18 +/- 2.10

Age >45 years: mean right 3.63 +/- 2.49 & left 3.82 +/- 2.15

Right p Value 0.4052 (NS) and left p Value 0.4568 (NS)

Graph 3d- Keros prevalence among the two genders on right and left sides



Type I Keros on right: Females 52.17% males 41.1%, Left: females 52.17% males 23.5%

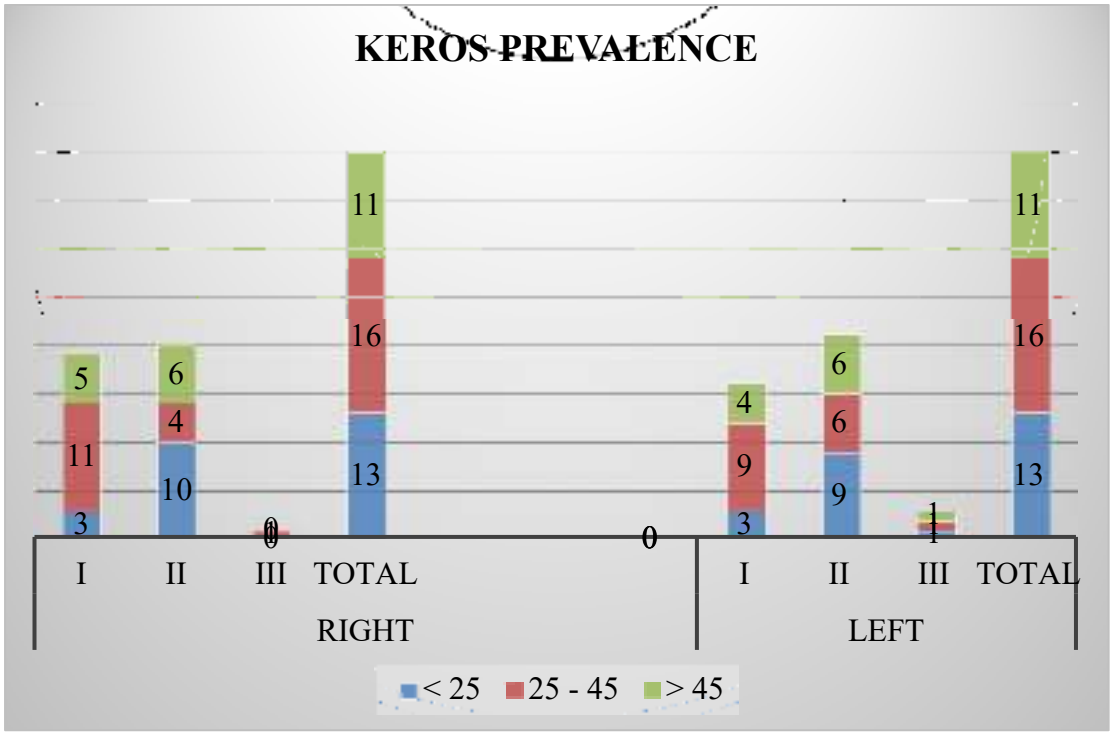
Type II Keros on Right: Females 43.47 % males 58.82% Left: Females 39.13% males 70.58%

Type III Keros on Right: Females 4.34% males 0 Left: Females 8.69% males 5.88%

P value was 0.4847 on right and 0.1387 on left (NS)

Graph 3e: KEROS prevalence among age groups

In the following Graph p value is calculated using one way analysis of variance (ANOVA)



Type I Keros: Right: Age <25years - 23.07% , age 25- 45 years 68.75% and age >45years 45.45% with p Value -0.0721 (NS)

Left: Age <25years - 23.07% , age 25- 45 years 56.52 % and age >45years 36.36% with p Value -0.4806 (NS)

Type II Keros: Right: Age <25years - 76.92% , age 25- 45 years 25% and age >45years 54.54% with p Value -0.0721 (NS)

Left: Age <25years - 69.23% , age 25- 45 years 37.5% and age >45years 54.54% with p Value -0.4806 (NS)

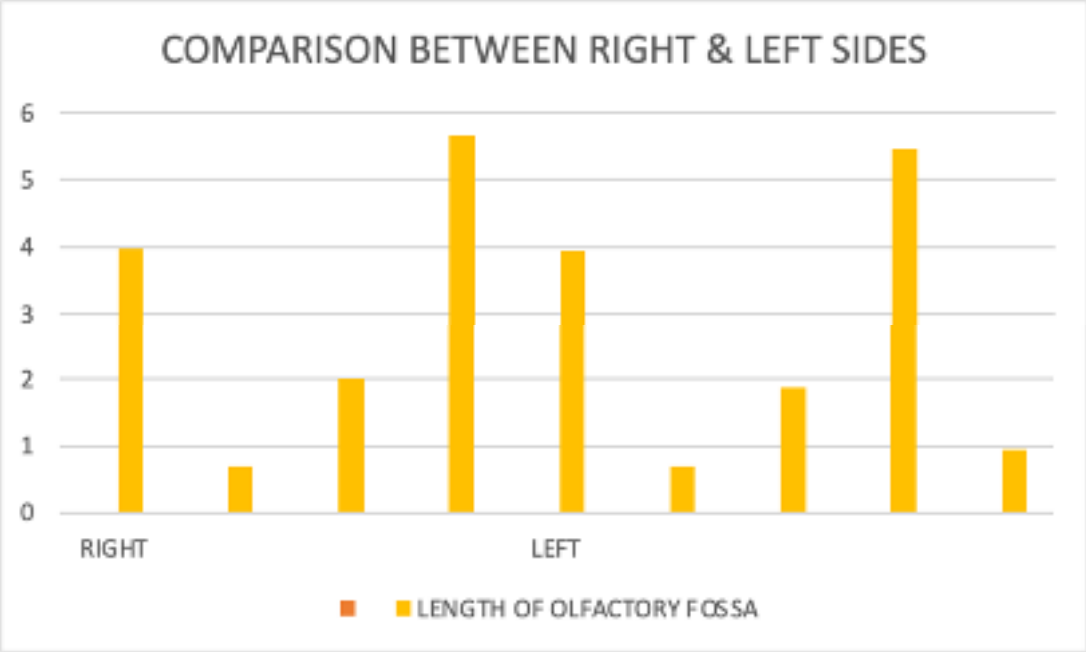
Type III Keros: Right: Age <25years -0 , age 25- 45 years 6.25% and age >45years 0 with p Value -0.0721 (NS)

Left: Age <25years - 7.69% , age 25- 45 years 6.25% and age >45years 9.09% with p Value -0.4806 (NS)

7- LENGTH OF

Graph 4a- Comparison between right and left sides

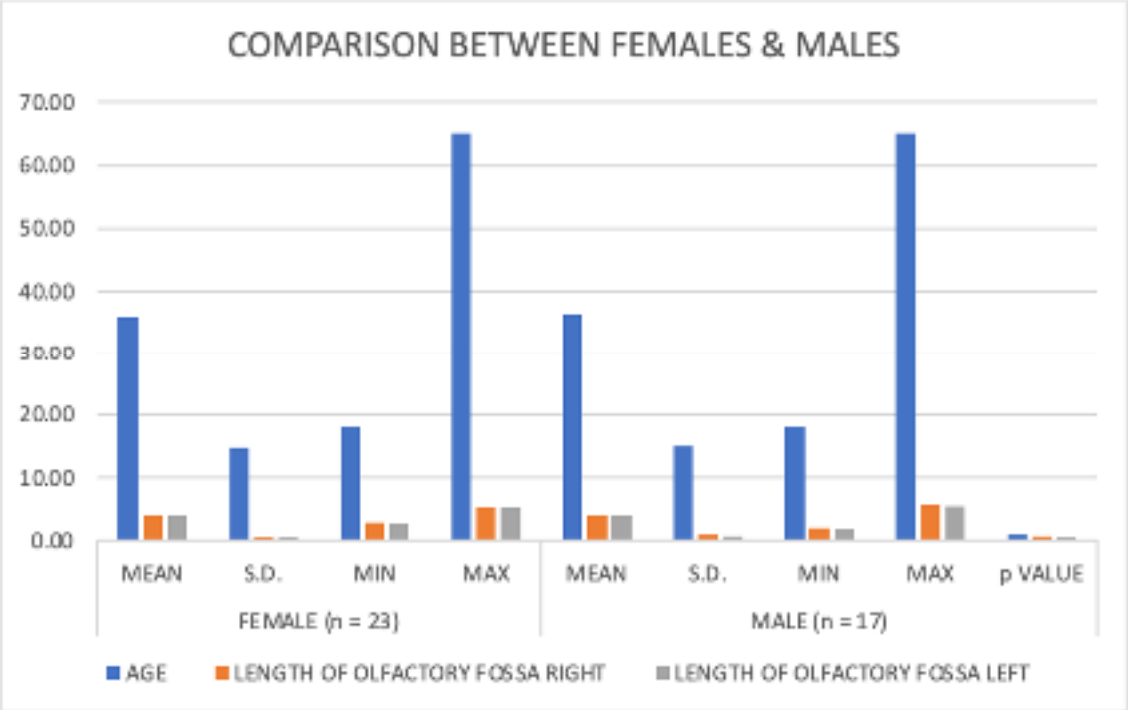
In the following graph p value is calculated using student's unpaired t test



The mean on the right was 3.97mm +/-0.69 and on left was 3.95 +/-0.70 with p Value of 0.9349 (NS)

Graph 4b- Comparison between females and males

In the following Graph p Value was calculated using student's unpaired t Test in comparison between females and males



In the study of length of the OF-

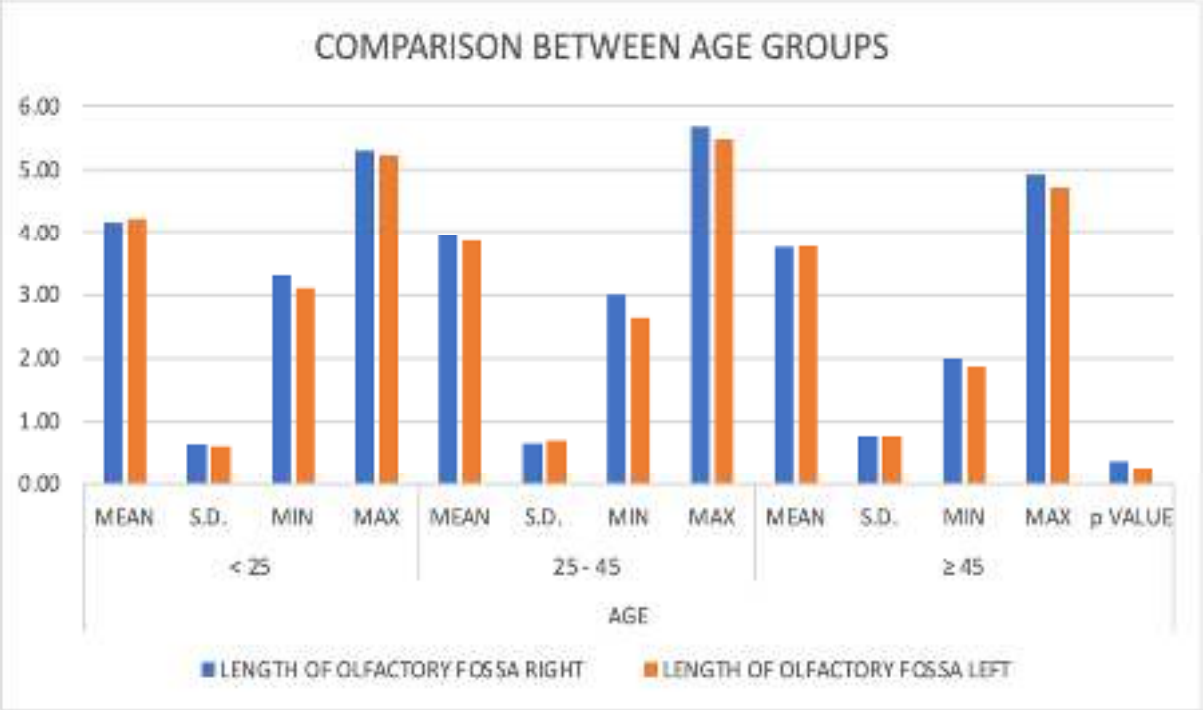
Females: Mean right 3.93 +/- 0.49 & left 3.90 +/- 0.60

Males: Mean right 4.01 +/- 0.91 & left 4.02 +/- 0.83

Right p Value 0.7441 (NS) and left p Value 0.6186 (NS)

Graph 4c- Comparison between age groups

In the following Graph p value is calculated using one way analysis of variance (ANOVA)



In the study of length of OF-

Age <25years: mean right 4.16 +/- 0.64 & left 4.21 +/- 0.62

Age 25-45 years: mean right 3.95 +/- 0.66 & left 3.86 +/- 0.69

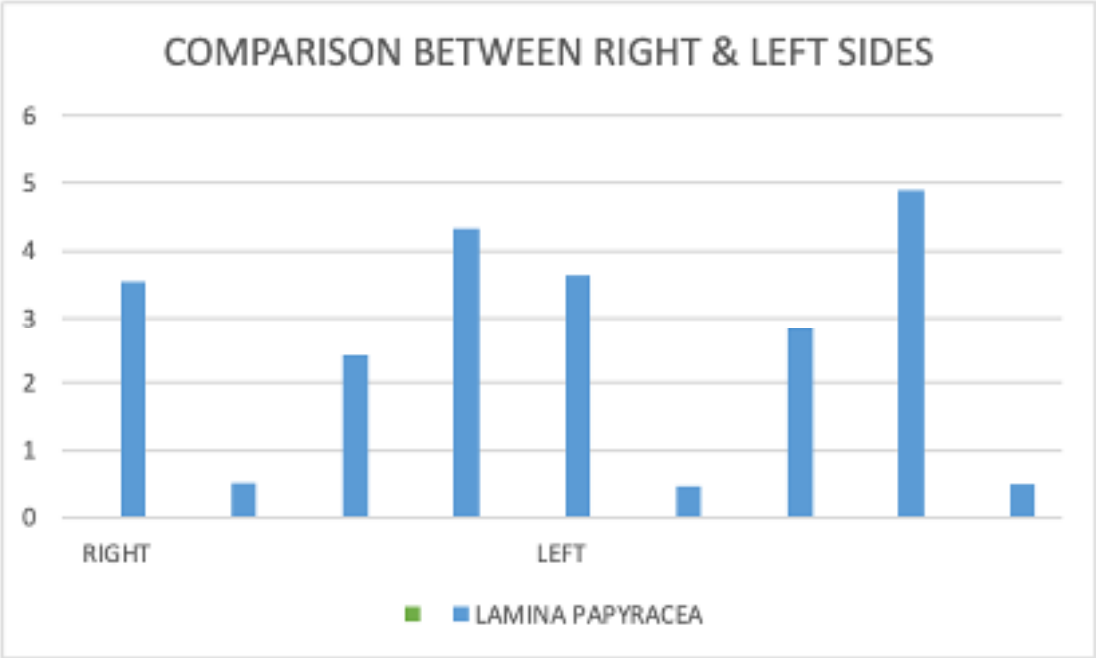
Age >45 years: mean right 3.76 +/- 0.78 & left 3.77 +/- 0.78

Right p Value 0.3660 (NS) and left p Value 0.2567 (NS)

5- LENGTH OF LAMINA PAPPYRACEA

Graph 5a- Comparison between left and right sides

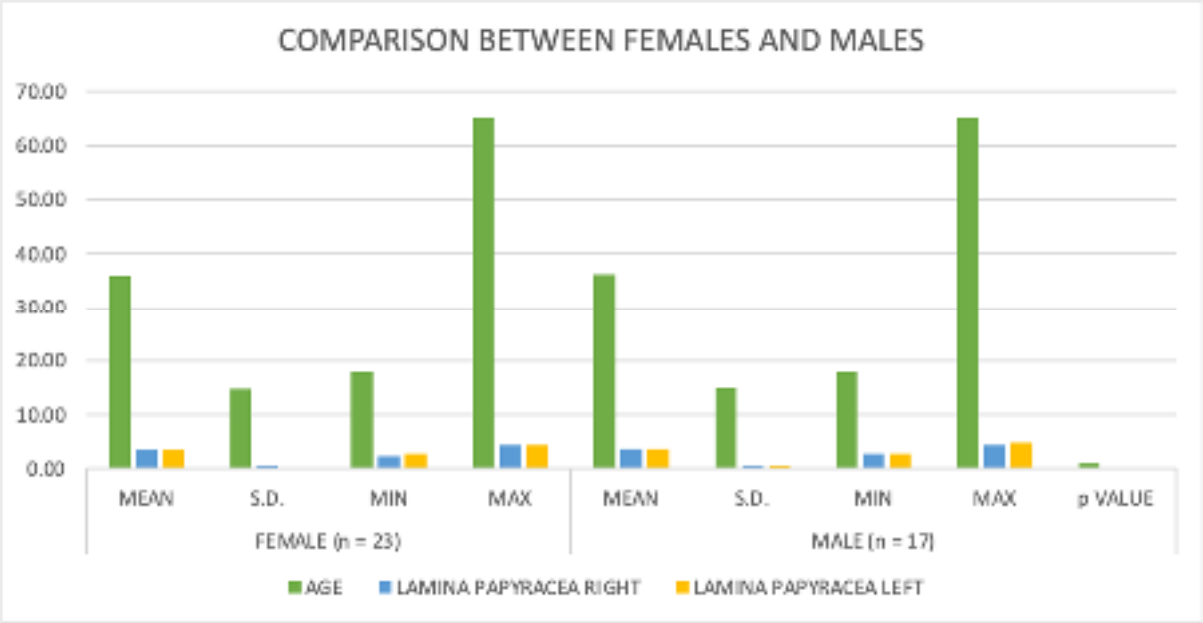
In the following graph p value is calculated using student's unpaired t test



The mean length of LP on right was 3.55mm +/- 0.52 and left was 3.763mm +/- 0.48 with p Value 0.5025 (NS)

Graph 5b- Comparison between females and males

In the following Graph p Value was calculated using student's unpaired t Test in comparison between females and males



In the study of length of LP-

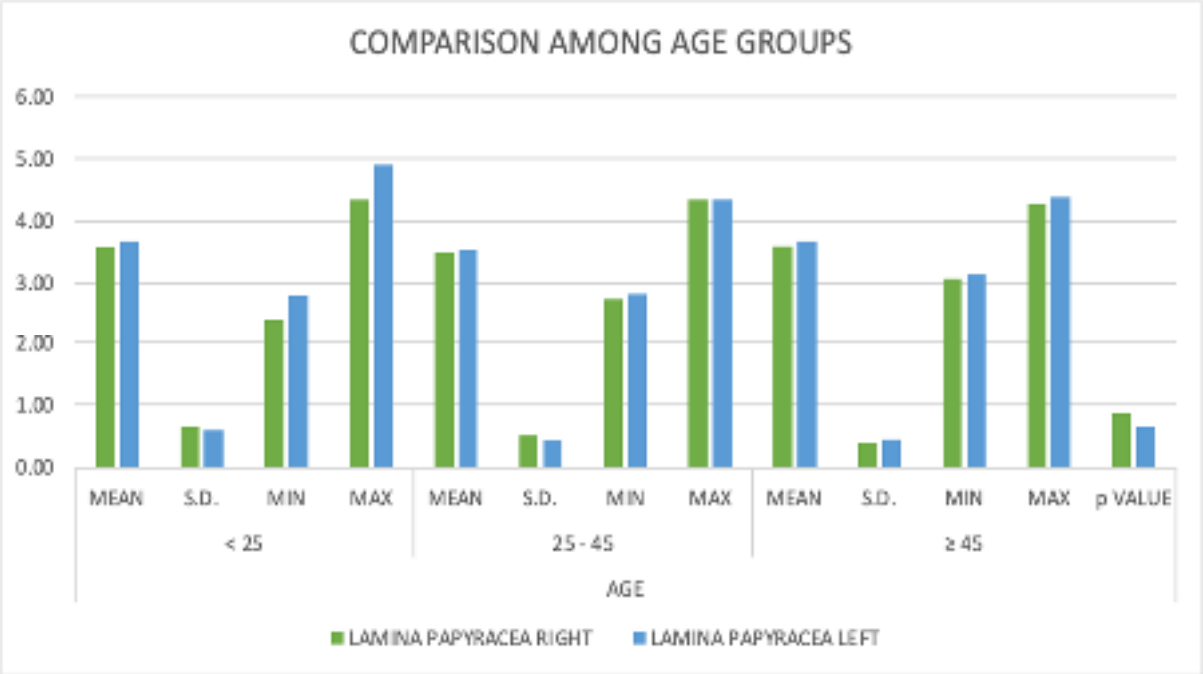
Females: Mean right 3.48 +/- 0.54& left 3.54 +/- 0.43

Males: Mean right 3.65 +/- 0.50 & left 3.75 +/- 0.53

Right p Value 0.3076 (NS) and left p Value 0.1765 (NS)

Graph 5c- Comparison between age groups

In the following Graph p value is calculated using one way analysis of variance (ANOVA)



In the study of length of LP-

Age <25years: mean right 3.57 +/- 0.65 & left 3.69 +/- 0.58

Age 25-45 years: mean right 3.50 +/- 0.52 & left 3.54 +/- 0.43

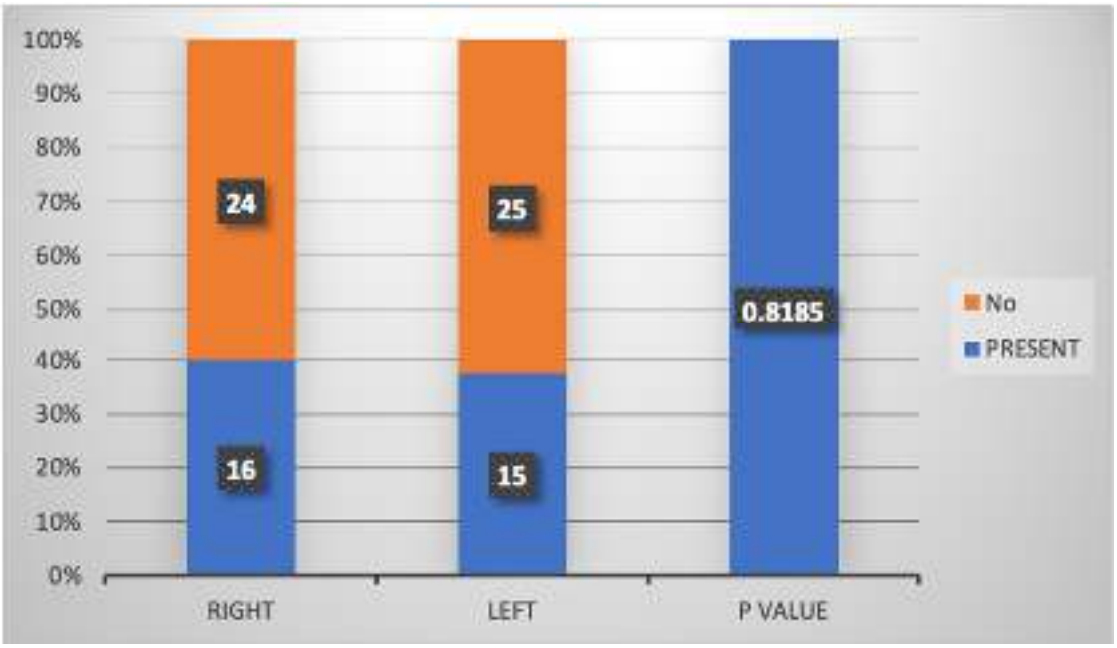
Age >45 years: mean right 3.60 +/- 0.39 & left 3.68 +/- 0.44

Right p Value 0.8722 (NS) and left p Value 0.6512 (NS)

6- CONCHA BULLOSA

Graph 6a- Comparison between right and left sides

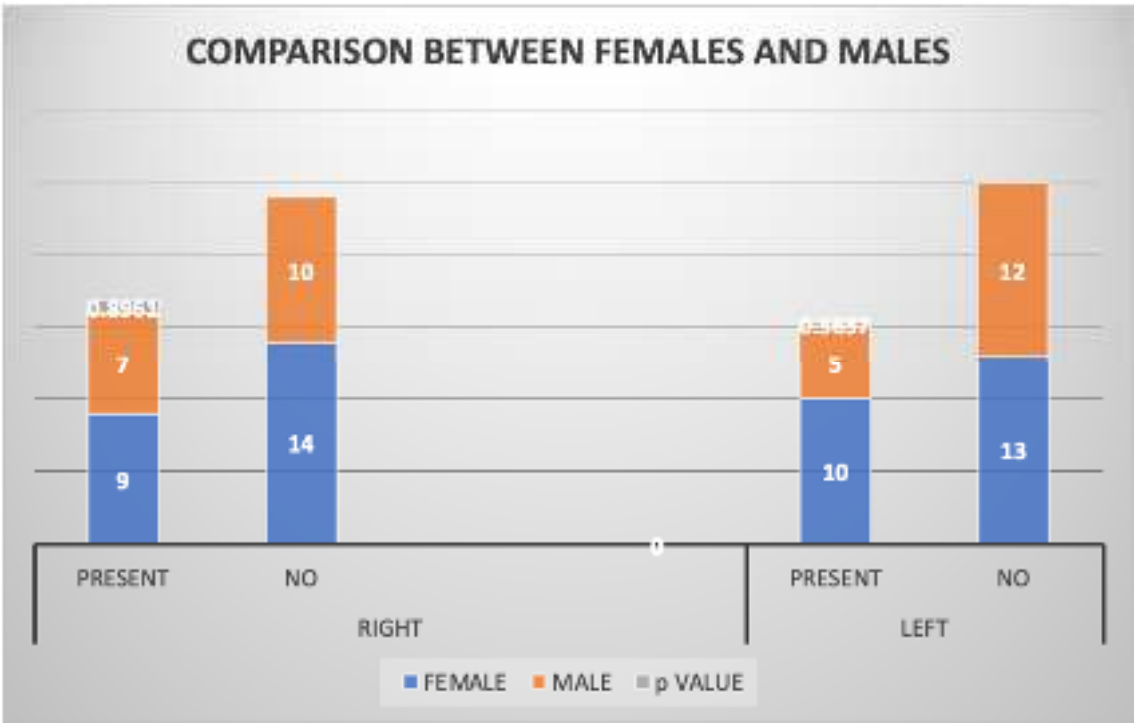
In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides



Concha bullosa was present in- right 40% and left 37.5% pValue 0.8185

Graph 6b- Comparison between females and males

In the following graph p Value is calculated using Chi-square-test to find the association between the presence and gender

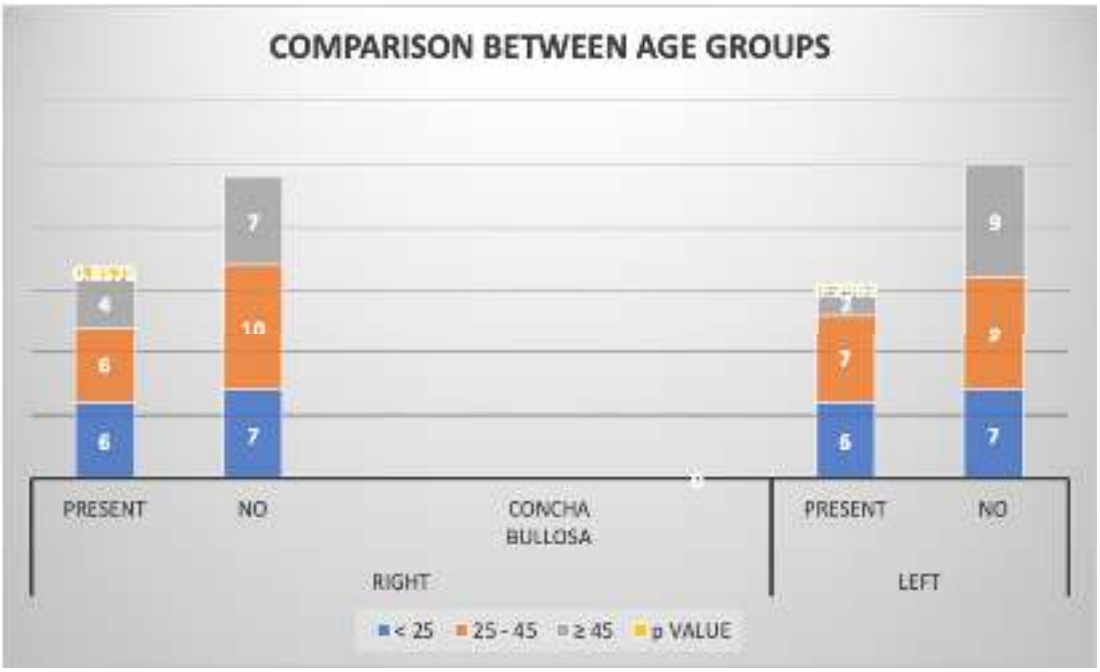


Concha bullosa (Right: female 39.1% and male 41.1% p Value 0.8961 (NS)

Left: Female 43.3% and male 29.4% p Value 0.3637 (NS)

Graph 6c- Comparison between age groups

In the following Graph p value is calculated using chi-square-test to find the association between presence and the age



Concha bullosa

age groups <25: right 15% and left 15%, age 25-45 years right 15% and left 17.5%, age >45 right 10% left 5%

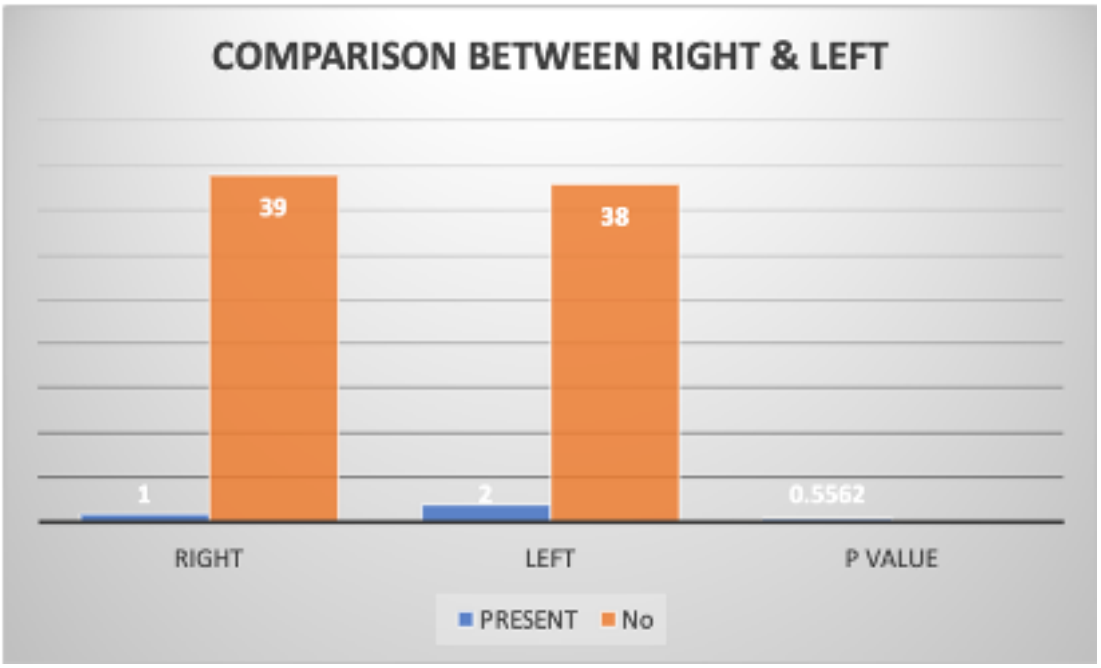
p Value on right was 0.8575 (NS)

p Value on left was 0.2962 (NS)

7- MEDIALISED UNCINATE PROCESS

Graph 7a- Comparison between right and left

In the following Graph p value is calculated using chi-square-test to find the association between presence and the two sides

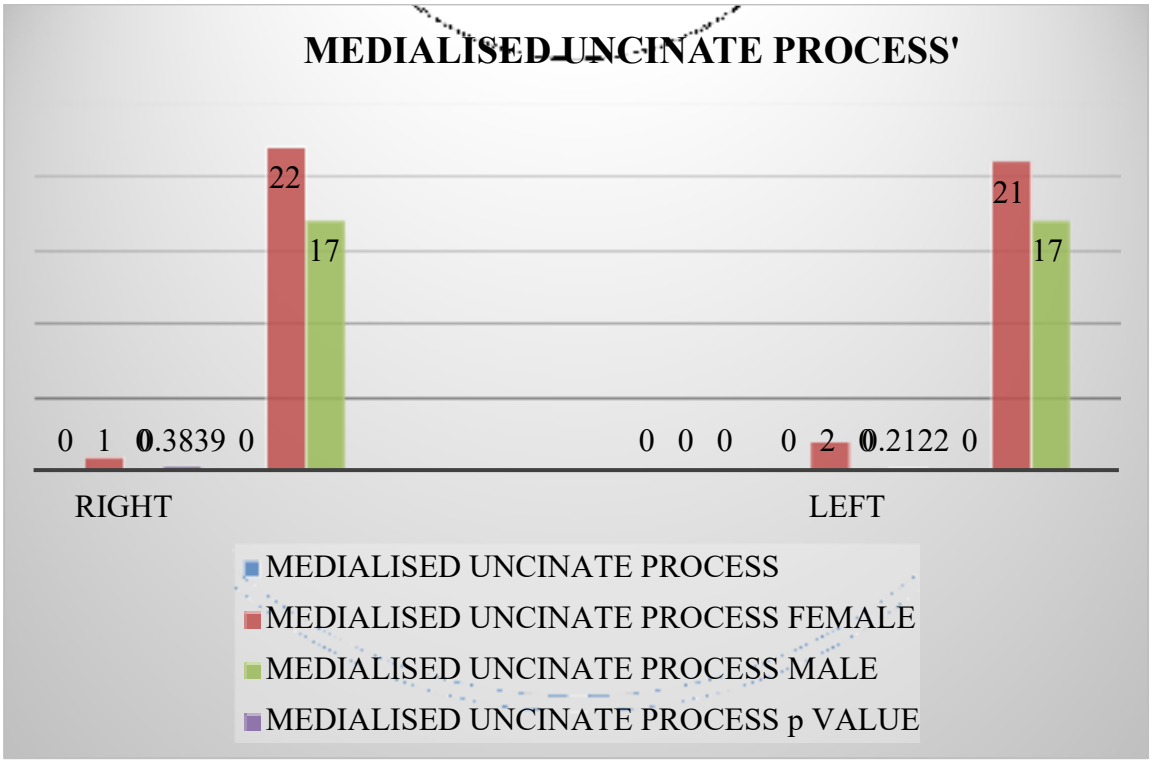


Medialised Uncinate process - right 2.5% and left 5%

p Value 0.5562 (NS)

Graph 7b- Association between gender and presence

In the following graph p Value is calculated using Chi-square-test to find the association between the presence and gender



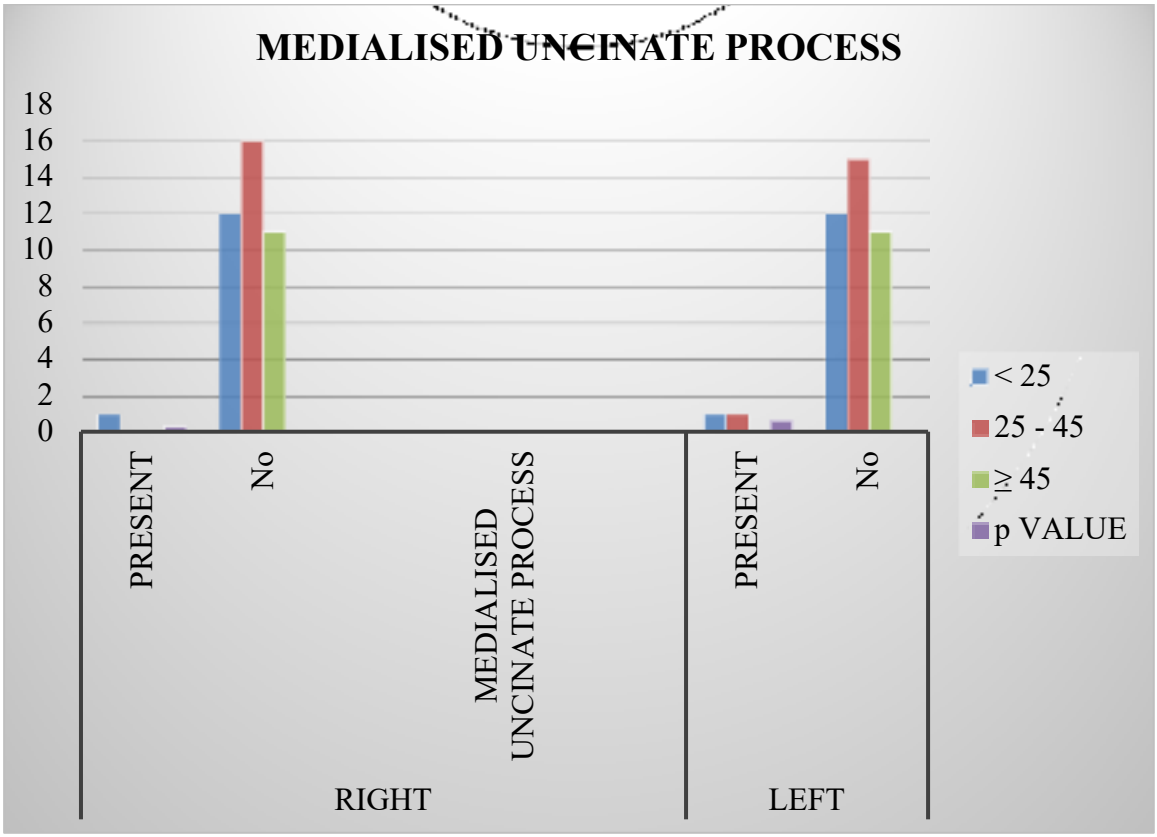
Medialised Uncinate process

Right: Female 4.3% and male 0, Left: Female 8.6% and male 0

Right p Value 0.3839 (NS) left 0.2122 (NS)

Graph 7c- association between Presence and age

In the following Graph p value is calculated using chi-square-test to find the association between presence and the age



Medialised Uncinate process-

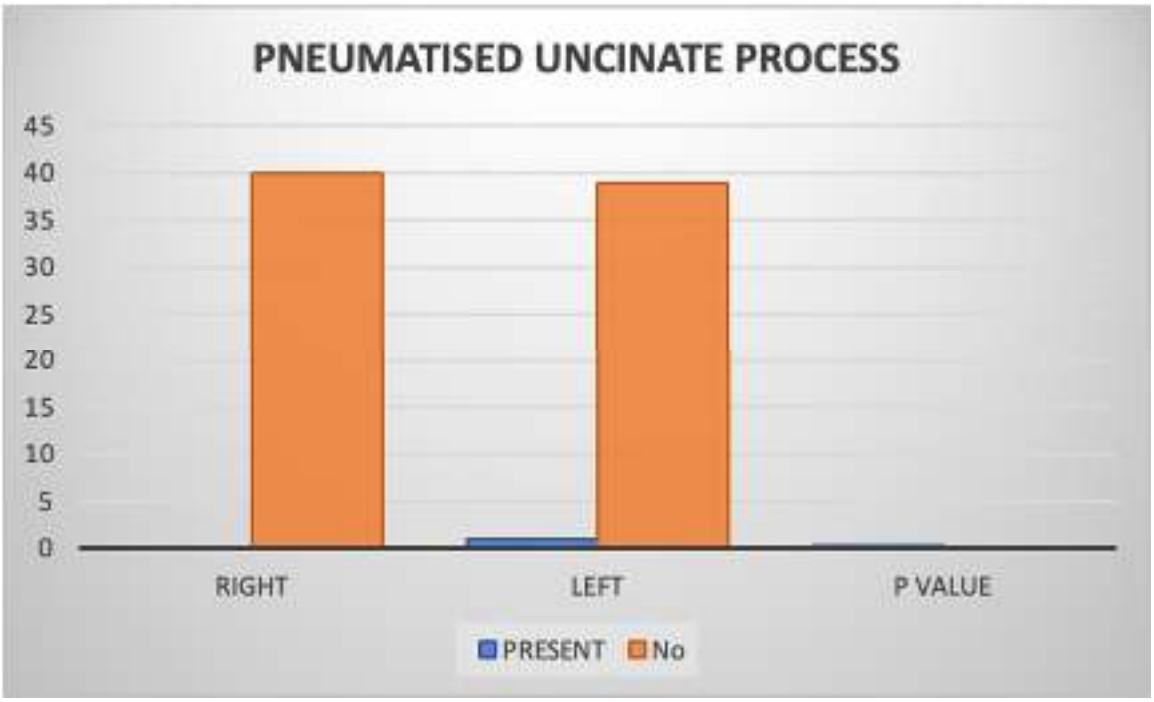
age groups <25: right 2.5% and left 2.5%, age 25-45 years right 0 and left 2.5%, age >45 right 0 left 0

Right p Value 0.3447 (NS) and Left p Value 0.6604 (NS)

8- PNEUMATISED UNCINATE PROCESS

Graph 8a- Comparison between sides

In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides

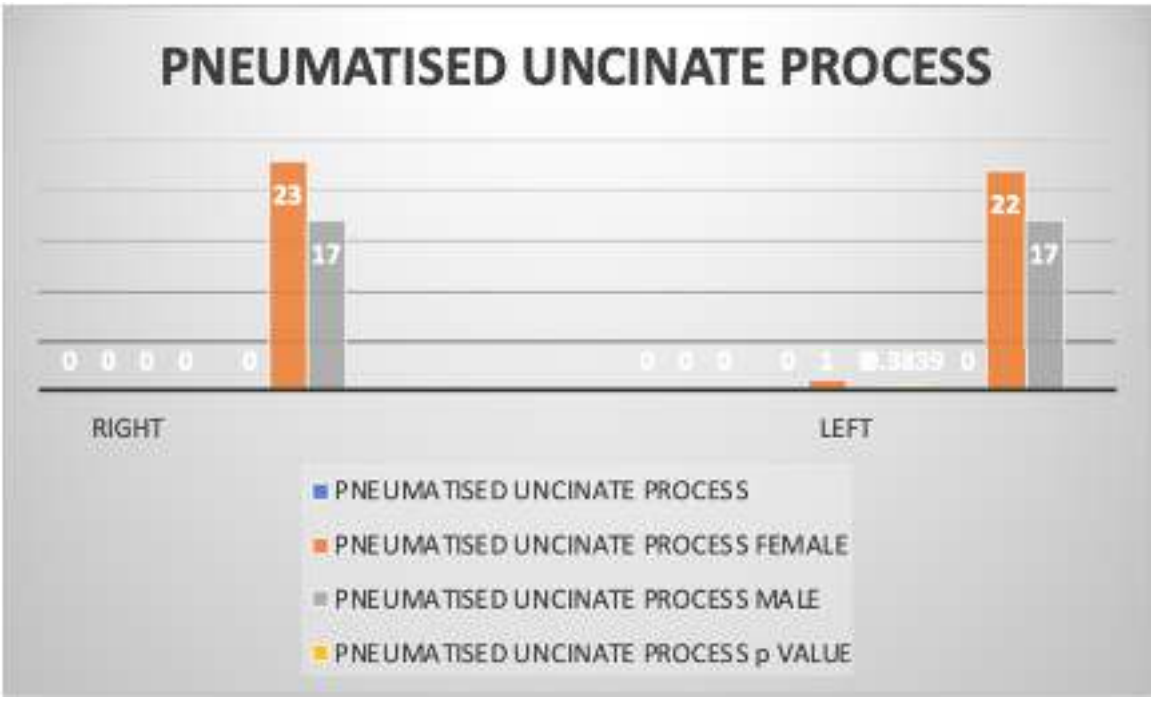


Pneumatized uncinate process right 0 and left 2.5%

P Value 0.3143 (NS)

Graph 8b- Association Between Presence And Gender

In the following graph p Value is calculated using Chi-square test to find the association between the presence and gender

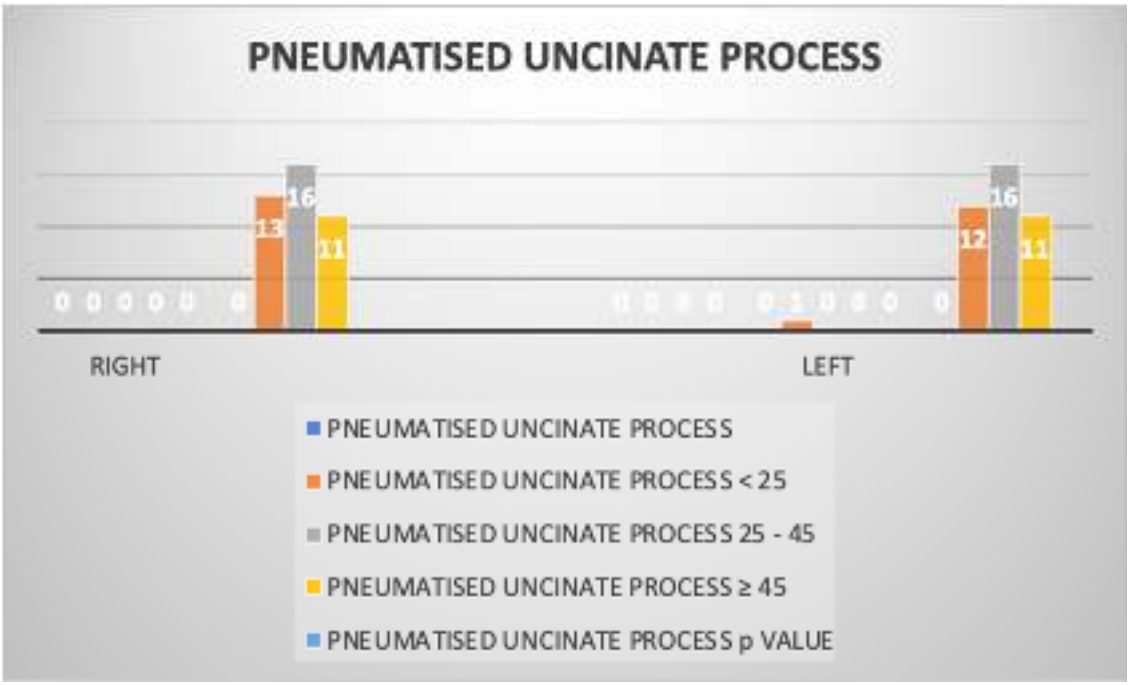


pneumatized uncinate process Right: Female and Male 0 and Left: Female 4.3% and male 0

Left p Value 0.3839 (NS)

Graph 8c- association between Presence and age

In the following Graph p value is calculated using chi-square test to find the association between presence and the age

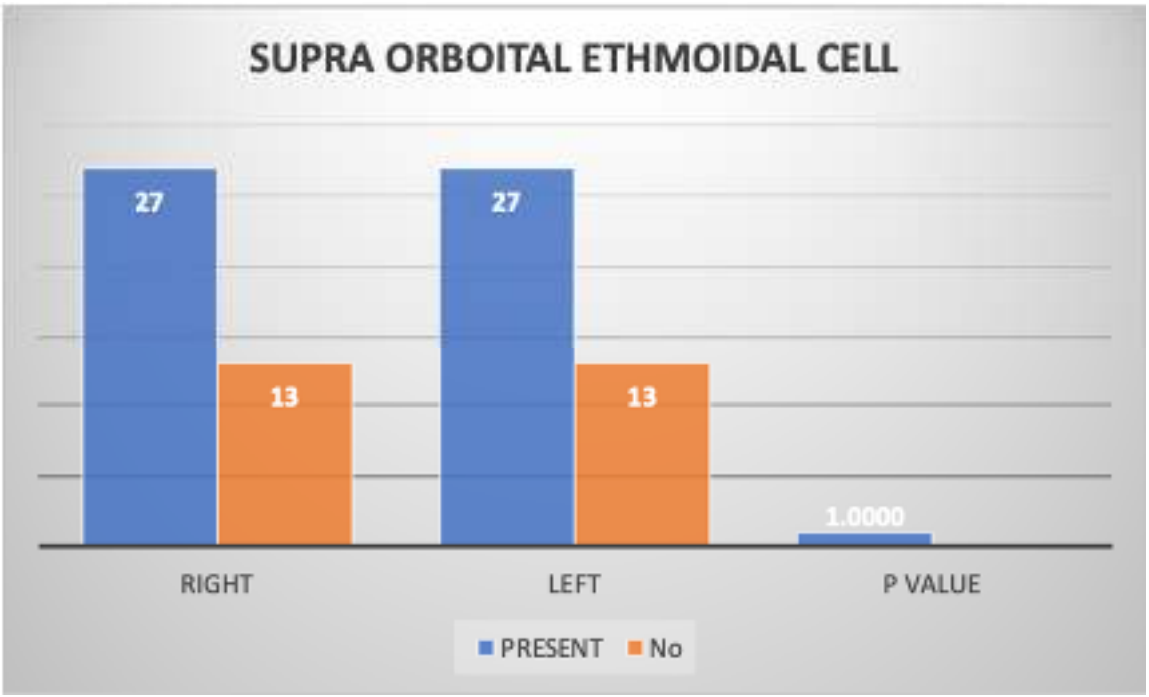


pneumatized uncinate process age <25 right 0 and left 2.5%, Age 25 – 45 right & left 0, >45 age right and left 0

9- SUPRA ORBITAL ETHMOIDAL CELL

Graph 9a- association between presence and two sides

In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides

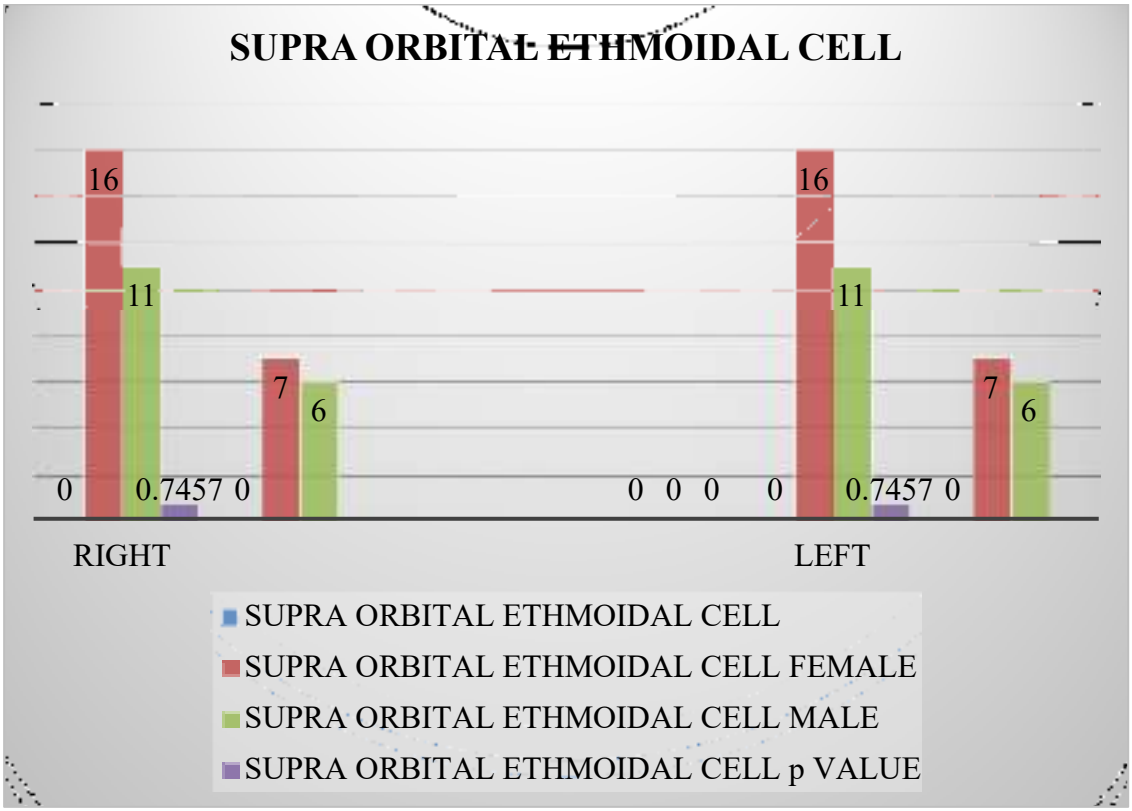


supra orbital ethmoidal cell - right 67.5% and left 67.5%

p Value 1.000 (NS)

Graph 9b- Association Between Presence And Gender

In the following graph p Value is calculated using Chi-square test to find the association between the presence and gender

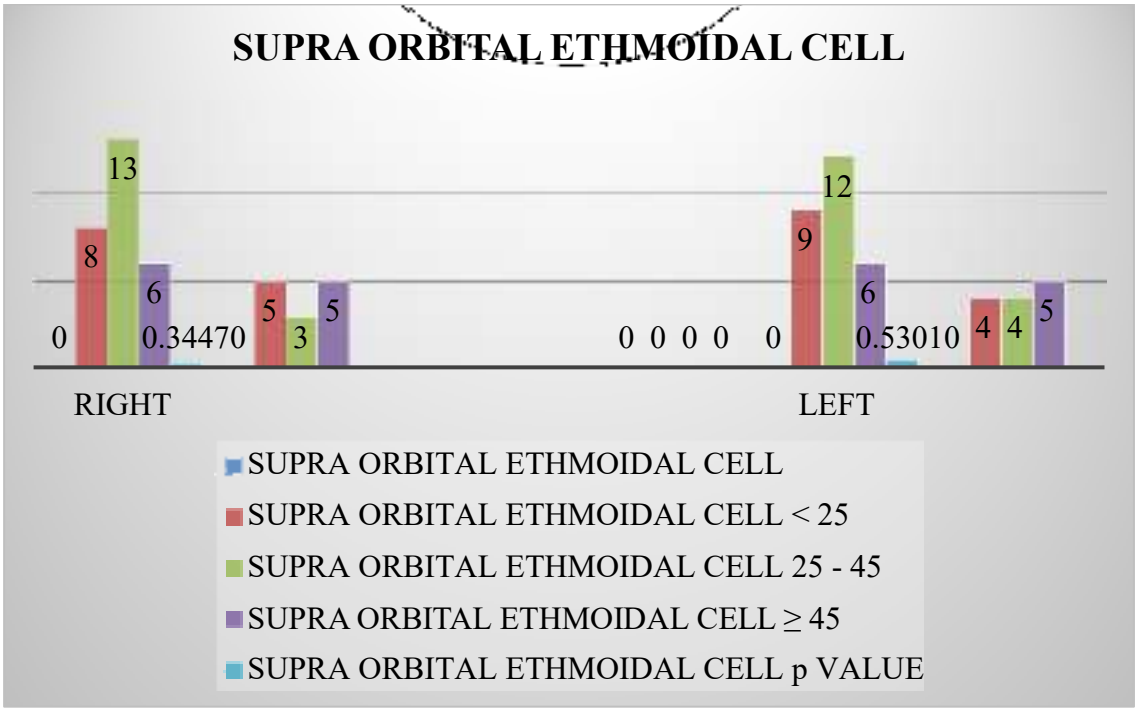


supra orbital ethmoidal cell Right: Female 69.5% and male 64.7%, Left: female 69.5% and male 64.7%

right p Value 0.7457 (NS) left 0.0457 (NS)

Graph 9c- association between Presence and age

In the following Graph p value is calculated using chi-square test to find the association between presence and the age



supra orbital ethmoidal cell

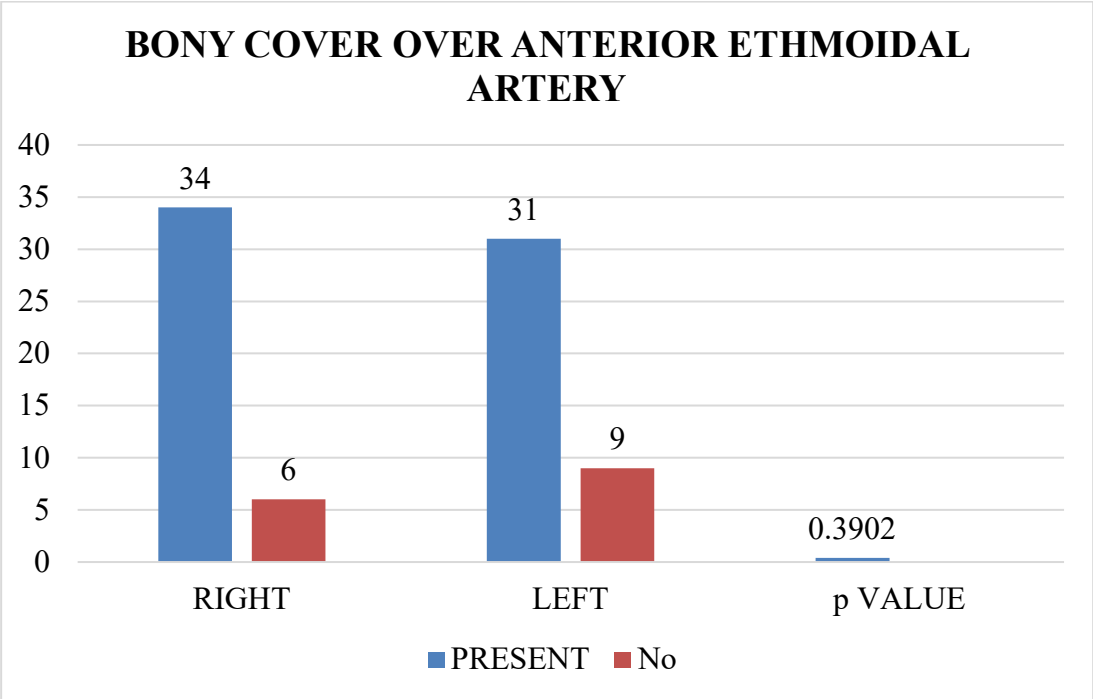
age groups <25: right 20% and left 22.5%, age 25-45 years right 32.5% and left 30%, age >45 right 15% left 15%

right p Value 0.3447 (NS) left 0.5301 (NS)

10- BONY COVER OVER ANTERIOR ETHMOIDAL ARTERY

Graph 10a- association between presence and two sides

In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides

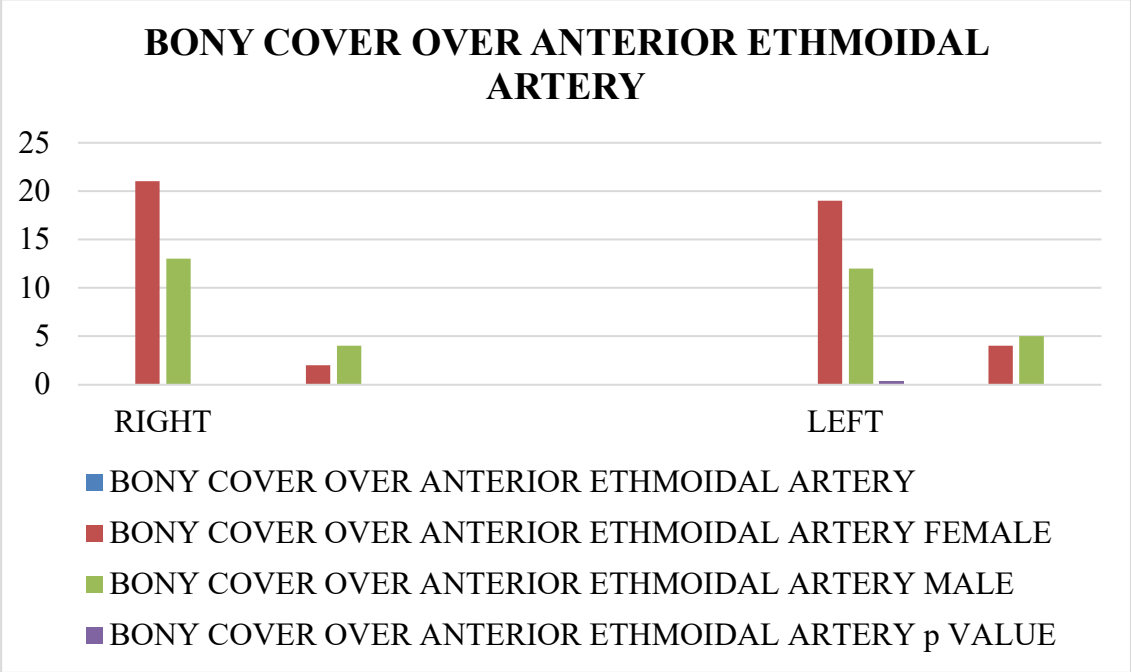


The presence of bony cover over anterior ethmoidal artery right 85% on the Left 77.5%

P Value 0.3902 (NS)

Graph 10b- Association Between Presence And Gender

In the following graph p Value is calculated using Chi-square test to find the association between the presence and gender

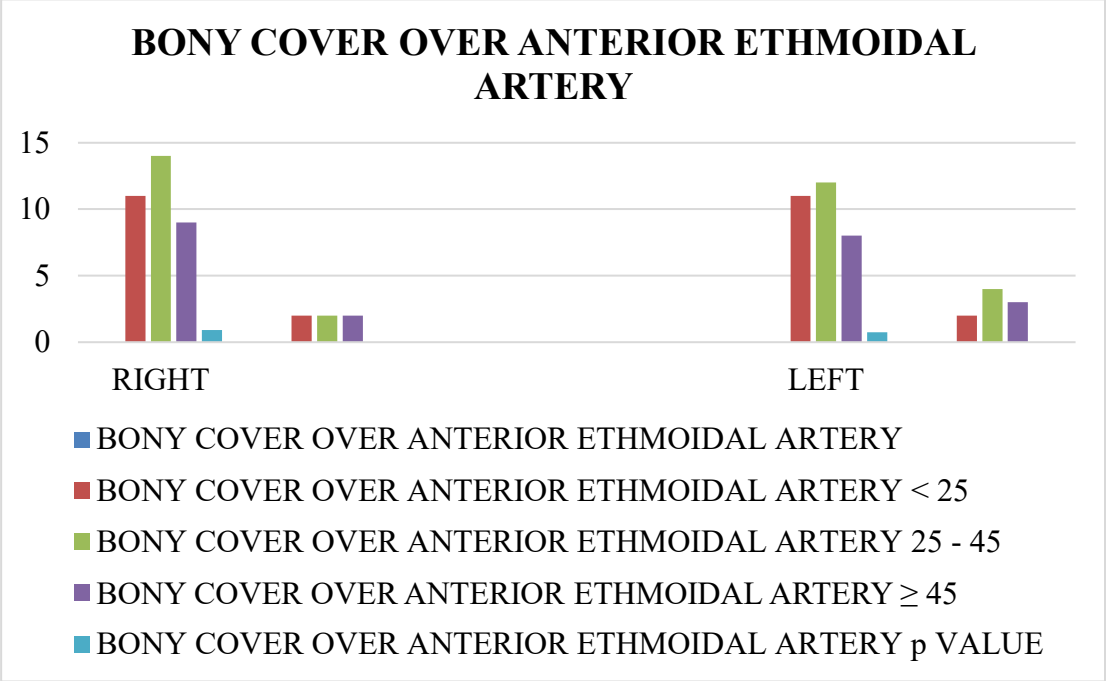


The presence of bony cover over anterior ethmoidal artery right: Female 91.3% and male 76.4% Left: females 82.6% and right 70.5%

Left p value: 0.3681 (NS)

Graph 10c- association between Presence and age

In the following Graph p value is calculated using chi-square test to find the association between presence and the age



The presence of bony cover over anterior ethmoidal artery age groups <25: right 27.5% and left 27.5%, age 25-45 years right 35% and left 30%, age >45 right 22.5% left 20%

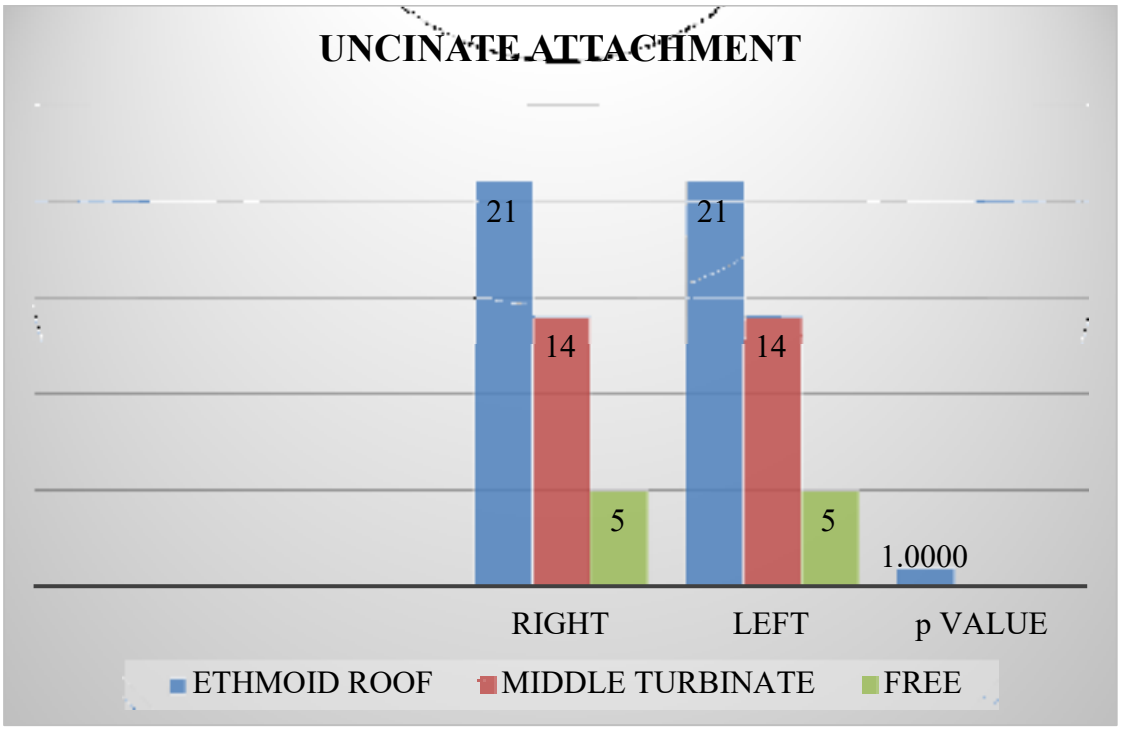
Right p Value 0.9198 (NS)

Left p Value 0.7488 (NS)

11- UNCINATE ATTACHMENT

Graph 11a- association between presence and two sides

In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides



the attachment of the uncinate process:

Ethmoid roof right 52.5 % and left 52.5%,

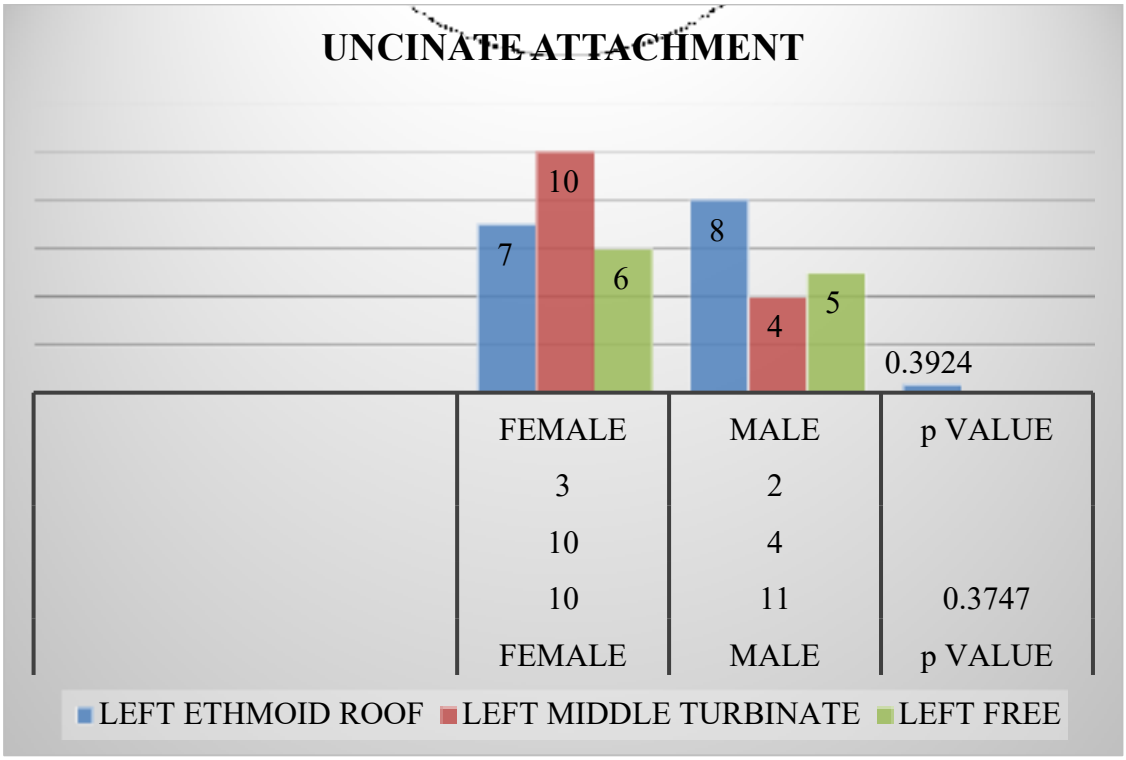
Middle turbinate attachment right 35% and left 35%

free end right 12.5% and left 12.5%

p Value 1.000 (NS)

Graph 11b- Association Between Presence And Gender

In the following graph p Value is calculated using Chi-square test to find the association between the presence and gender



the attachment of the uncinate process:

Ethmoid roof- right: female 43.4% and males 64.7% Left: females 30.4% and males 47%

Middle turbinate attachment: Right: female 43.4% and males 23.5% Left: female 43.4% and males 23.5%

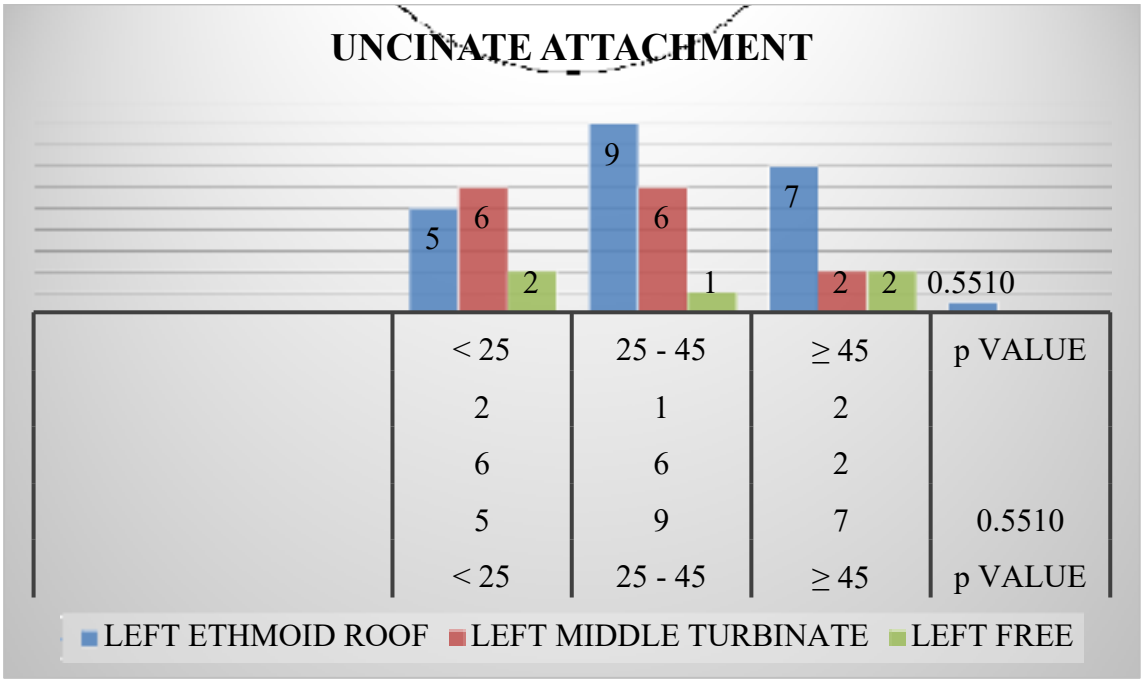
free end Right: female 13.04% and 23.5% in males; Left: females 26% and males 29.4%

right p Value 0.3747 (NS)

Left p Value 0.3924 (NS)

Graph11c- Association Between Presence And Age

In the following Graph p value is calculated using chi-square test to find the association between presence and the age



the attachment of the uncinate process :

Ethmoid roof : age <25: Right 12.5% and Left 12.5%; age 25-45 years: right 22.5% and left 22.5% and age >45 right and eft 17.5% on both sides

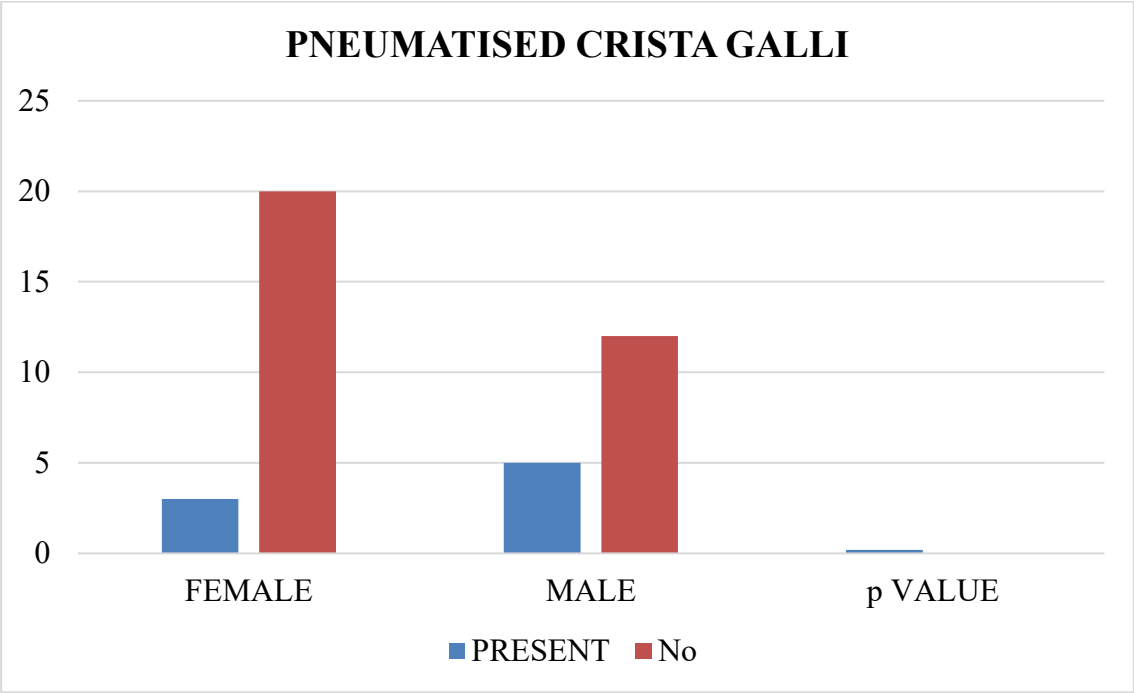
Middle turbinate attachment: age <25: Right 15% and Left 15%; age 25-45 years: right 15% and left 15% and age >45 right 5% and left 5% free end: age <25: Right 5% and Left 5%; age 25-45 years: right 2.5% and left 2.5% and age >45 right 5%and left 5%

Right p Value 0.5510 (NS) & Left p Value 0.5510 (NS)

12- PNEUMATISED CRISTA GALLI

Graph 12a- Association Between Presence And Gender

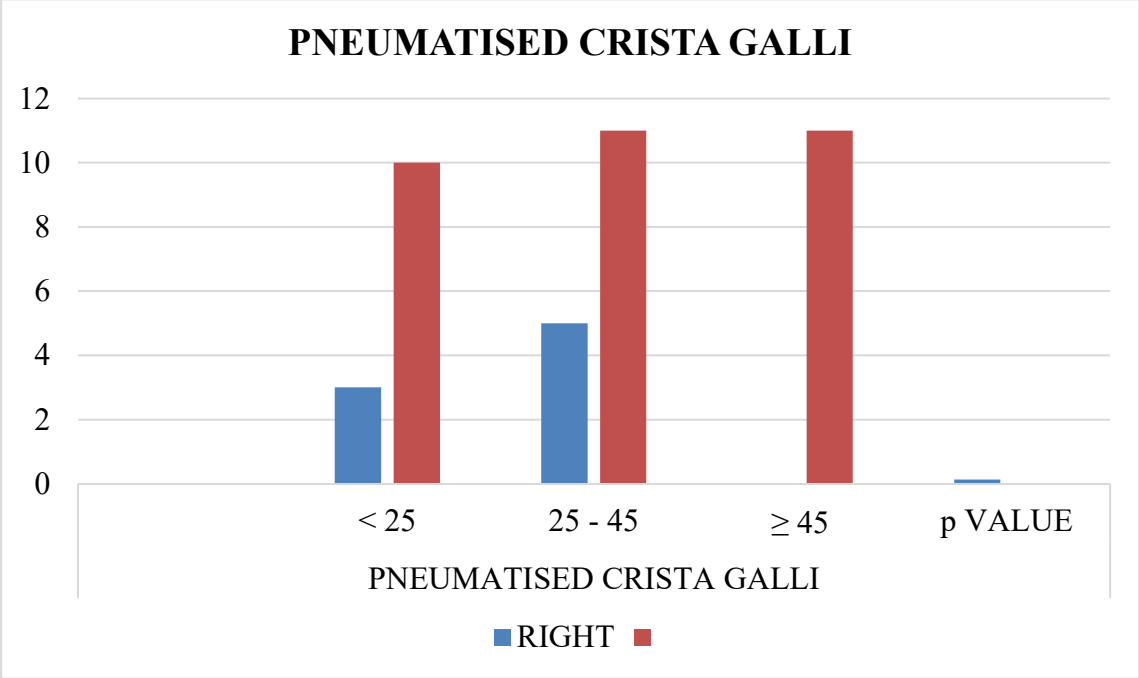
In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides



Pneumatized crista galli 13.04 % in females and 29.4% in males p Value 0.2008 (NS)

Graph 12b- Association Between Presence and Age

In the following Graph p value is calculated using chi-square test to find the association between presence and the age



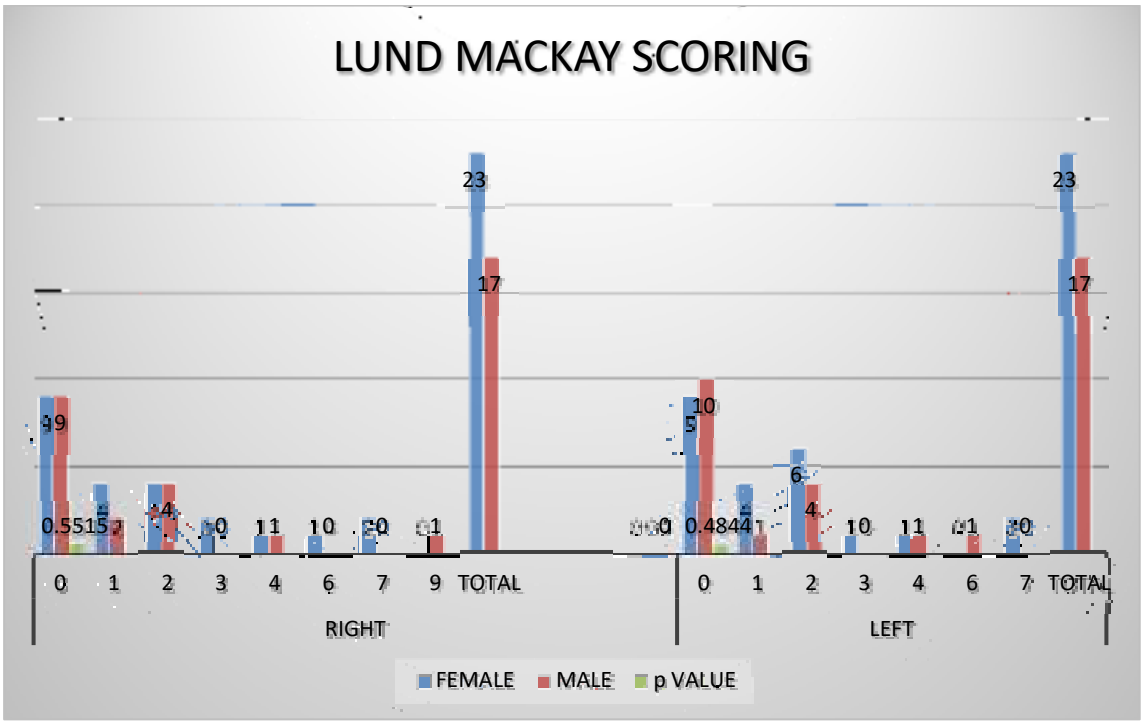
Pneumatized crista galli: age groups <25: 7.5%, age 25-45 years 12.5% , age >45 0

p Value 0.1292 (NS)

13-LUND MACKAY SCORING

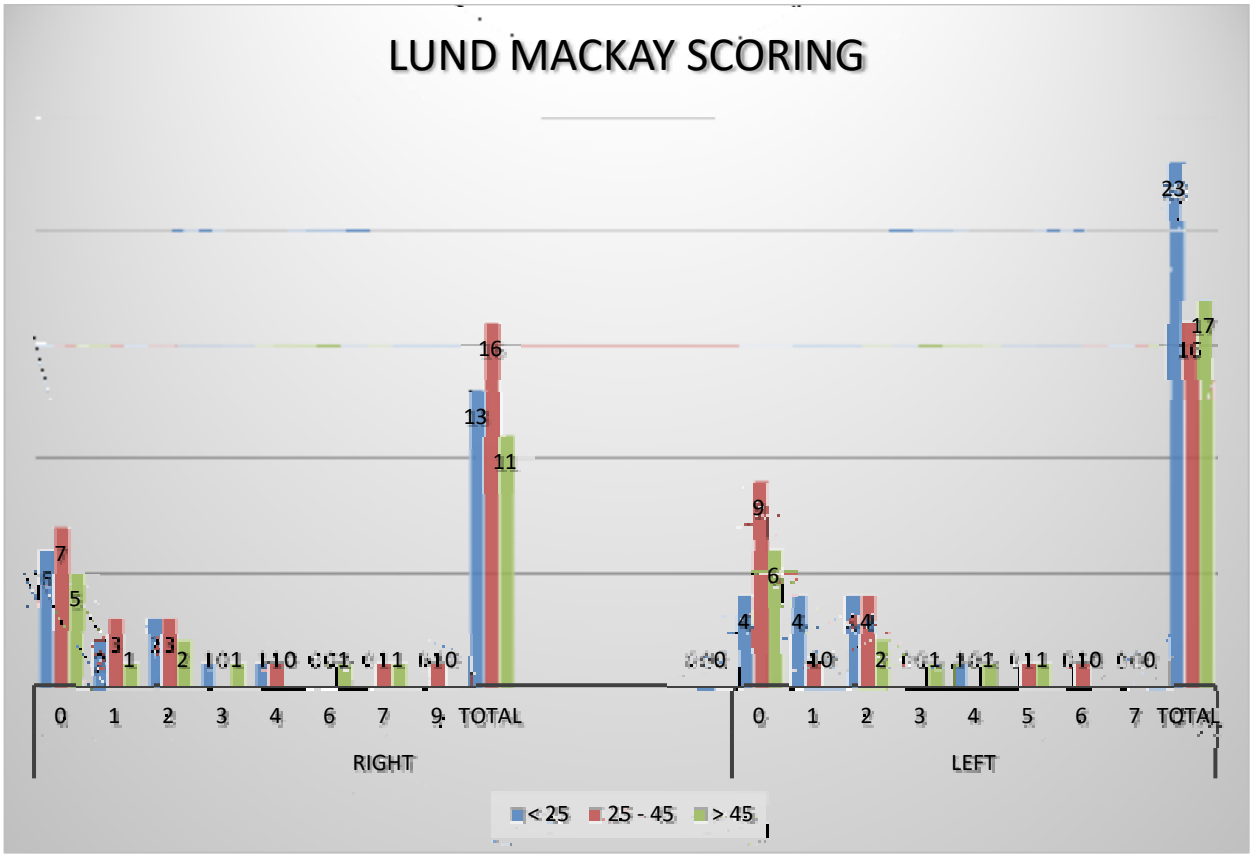
Graph 13a- Lund Mackay scoring between gender

In the following Graph p value is calculated using chi-square test to find the association between presence and the two sides



Graph13 b- Lund Mackay scoring between age groups

In the following Graph p value is calculated using chi-square test to find the association between presence and the age



DISCUSSION

Knowledge of anatomy and its variations is of vital importance to the surgeons to prevent untoward complications. The ASB is made of complex vital structures with varied anatomical variations. the aim of this study was to determine the profile of variation in ASB seen on Computed Tomography scans of PNS.

Computed tomography has an important role in sinonasal diseases, apart from aiding the diagnosis, the pre-operative evaluation of the PNS and its adjacent structures , it plays a vital role in highlighting various possible anatomic variations which provide a safe surgical roadmap to the surgeons.[2]

The gender distribution in the study was 23 females and 17 males with a total sample size of 40 and for the sake of comparison age distribution was divided into 3 age groups i.e., <25years, 25 to 45 years and more than 45 years of age. Each of the study parameters were compared between the 2 genders, age groups and right and left sides to assess the prevalence in the Indian population. (Graph 1 a&b)

In this study, septal deviation was found to be the most commonly found anatomical variation of an average of 6.79^0 on the right and 7.48^0 on the left. (Table 1a,b &c)When it was compared among the age groups and gender no statistical significant association was seen between groups. According to study done by Cellina M et al, observed left sided deviation was more commonly seen and also said that septal deformities are more common than a non-deviated septum .[16] Study done by Farhan N et al, showed that DNS was the most common anatomical variation in the PNS.[17]

The AEF is a bony landmark for the identification of AEA, this bony landmark is easily detectible on CT scans.[6,27] In this study it was found that AEF was present in all samples 100% when measured from the nasal floor & IOF. Nasal floor is essential and reliable landmark just as the infraorbital foramen.[20] (Table 2 a, b & C)

However there was no statistically significant difference between measurements when they were compared between right and left sides, gender and age groups. Other similar by Abdullah B et all[1] , El- Anwar et al[18] and Souza et all[8] have reported almost 100% presence of this bony land mark and its significance for the localization of AEA.

In the course of AEA, It turns anteriorly after intracranial entrance into the OF, forming the AES in the CP's LL, this AES is the site of highest weakness of the entire ASB.[1,8,38] Thus, the position of the AEA serves as an important landmark for the localisation of AEA. In this study AES was seen in all the scans no significant was found in its location when compared between gender and age groups. Study by Souza et al observed AES in 98% of their study population, therefore suggesting it as a reliable anatomical landmark.[8]

The angle between LL-CP at the level of AEA showed a mean of 98.31^0 to the left and a mean of 103.76^0 on the right, further when compared between age groups an angle of $>92^0$ was observed in all age groups, when compared between genders, both groups showed an angle of $>95^0$. (Table 3 a, b & c) According to a study done by El-Anwar et al, showed that 87% of their study population had $>90^0$ angle between LL and CP.[18] Similarly Asal N et al, found that patients with lower angle will be dangerous as compared to a higher LLCPA.[32]

The height of behind the anterior 1/3rd of measured in coronal cuts showed an average height of >3mm on either side. In females it was >3.5mm and in males it was found be >4mm, in age group comparison, all groups had an average height of >3.8mm was observed on both sides. (Graph 2a, b&c) Greater the height of the OF more is danger of intracranial penetration during the ESS procedures.[2] Study done by T.M Jones et al, found no significant difference in height of OF when compared with age groups and gender.[26]

The height of was measure by subtracting the length of the median ethmoidal roof height from the length of LL of the CP. It was measured in coronal cuts and classified. (Graph 3 a,b,c,d&e)

Based on Keros classification the OF depth was further classified into type-I, type-II and type -III. In this study, on the right side Type-I-keros was seen in 52% females & 41.1% in males, type-II was seen in 43% females & 43% males & type-III was seen in 4.3% female only. On the left side , type- I was seen in 52% females and 23.5% males, Type-II was seen in 39.1% females & 70.5% males and Type-III was seen in 8.6% females and 5.8% male. When the same was categorized into the 3 age groups the following was found, in age group <25 years, on the right-side Type-I was seen in 23%, Type-II in 76.9% & Type-III was absent. On the left side, Type-I was seen in 23%, Type-II in 69.2% & Type-III in 7.6%. In age group of 25 to 45 years, on the right side- Type-I was seen in 68.7%, Type-II in 25% and Type-III in 6.25%. On the Left side, Type-I was seen in 56.25%, Type-II in 37.5% and Type-III in 6.25%. And in the age group of >45years, on the right side, Type -I was seen in 45.4%, Type-II in 54.5% and no Type -III were seen. On the Left side, Type-I was seen in 36.3%, Type-II in 54.5% & Type-III in 9%. Similar studies have

shown varied prevalence of Keros, most often Type-I and II being the most commonly observed variants and rarely type-III and also the dangerous type, also significant amount variations can co-exist with regards to Type of Keros in the same patient on either side. Suggesting the need for pre-operative CT evaluation for any ESS or skull base procedures.[7,21,22, 23, 24,27]

In this study the length of OF i.e. CP length was measured in axial cuts showed a mean of >3.95cm on either side when compared to age groups and gender. (Graph 4 a,b &c)Study done by Yenigun A et al, Classified the CP based on its length to measure the course of AEA and therefore emphasizing on a three-dimensional assessment of the course of AEA. Munoz-Leija M et al, observed that length of the CP was more in females compared to that in males.[21] Berger G et al found the length to be 13mm on both sides.[24]

Length of LP measured in axial cuts showed a. and average length of >3.5cm in the study population, no significant difference was seen on either side, among genders and age groups. (Graph 5 a,b &c) LP, in any ESS procedure is an important structural landmark for orbital and ethmoidal skull base relationship. However, no significant variations have been in found in similar studies done by Munoz-Leija M et al & Ramakrishna V et al in their study found LP to be an essential landmark to identify the orbit. [21,28] Acar G et al in their study of 100 CT scans found a mean length of 3.33 +/-2.9 cm in their study population, similar to that of this study. [31]

The presence of concha bullosa was evaluated for anatomical variations, it was the second most common variation found in the study, 40% as seen on right and 37.5%on the left side. (Graph 6 a,b &c)Tiwari et al and Iida E et al, Hannes B et al found that concha bullosa common and frequent anatomical variant on CT

scans.[29,30,41] Gibelli D et al observed that different geographic areas have a varied prevalence of concha bullosa ranging from 4.2% to 35%.[42]

Presence of Medialised uncinate process as seen in coronal cuts, it was found that in in age group of <25 years, it was observed in 7.69% on both sides. (Graph 7 a,b &c)When compared between genders, was present in 13% of females while absent in males. In a study done by Tuli I et al, found about 24% of prevalence of medialized uncinate process.[33]

Presence of pneumatized uncinate process as seen in coronal cuts were present in 2.5% of study population on the left and absent on the right, no significant association among the genders & age groups. (Graph 8 a,b &c)Cellina M et al termed it as "uncinate bulla" being the rarest variant seen in about 0.4 to 5% of cases.[16,] Tuli I et al observed that pneumatized uncinate process was seen in only 4%, similar to that of ours.[33]

Presence of supra orbital ethmoidal cell (SOEC) as seen in coronal cuts were present in 67.5% of the study group. (Graph 9 a,b &c) Predominant in the age group between 25 to 45 years and more often seen in females compared to that of males. Study done by Li Mingsi et al, observed that the incidence of SOEC is linked to a greater incidence of the AEA coursing below the level of the skull base , putting the artery at greater risk of damage. [34] W Jang D et al found an incidence of 53% of normally pneumatized SOEC, and considered it to be a consistent landmark for location of AEA.[35]

Presence of bony cover over AEA as seen in coronal cuts were present in 77.5% on left & 85% on right. No significant association was seen in relation to the gender and age groups. (Graph 10 a,b &c)

Presence of Pneumatized crista galli as seen in coronal cuts, was present in 20% of the study population. (Graph 12 a,b &c)The reported incidence of pneumatization ranges between 2.4 to 37.5% and no statistically significant variance was found among sex and age, as seen in this study.[14,36,37]

Uncinate attachment on the right side showed attachment to ethmoid roof 52.5%, middle turbinate 35% and free 12.5% on either side. (Graph 11 a,b &c)Berger G et al emphasized on preventing unintentional damage to AEA and CSF leaks & the need for a thorough examination of the relationship between LLCP and the trajectory of upper attachment of uncinate process.[24] Tuli P et al observed that superior attachment of uncinate was more common 67%.[38]

CONCLUSION

For surgeons, the current study provides a quantified analysis. operating on the skull base and PNS should be aware of possible anatomical variations such as the septum, concha bullosa, uncinate process, Anterior ethmoidal artery foramen, course of Anterior ethmoidal artery, Dimensions of OF, supra orbital ethmoidal cells all of which can be studied in a pre-operative CT scan. Thus, creating a roadmap for the surgical procedure and help prevent injury to the vital structures of the skull base and para nasal sinuses.

This study also reports the sex and age-related differences of the anatomical variations. The most common anatomical variation was seen in the nasal septum, showing deviation to the right in 62.5% of the study and 37.5% to the left. Followed by Variations in the ASB, in females on the right Type-II > type -1 and equally seen on both side in males. On the left type-I>Type-II in females and males Type-II>type-I. The presence of AEF was seen in 100% of study population thereby proving to be a reliable landmark for the AEA. In It is practically not possible to assess all the finer details of vital structures intra operatively therefore, using standard CT imaging rare and unusual anatomical variations can be identified prior to the surgery avoiding any untoward intra operative complications.

All recent studies thus far have been done to corelate only few vital landmarks for any ASB or ESS procedures. Similarly, this study also included all anatomical landmarks of the ASB in order to gain in depth knowledge of any possible and prevalent anatomical variation. With the rising need for ASB approaches in our country for ASB tumors, CSF leak repairs and endoscopic sinus surgeries. This study assesses the possible radiological variations that can exist in the Indian population.

SUMMARY

This study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Jawaharlal Nehru Medical college and KLES Dr. Prabhakar Kore Charitable Hospital from January 2020 to December 2020. The goal of this study was to find out the anatomical variations in ASB helping us to gain more information regarding it's complex and vital anatomy.

- In this study 40 CT Scans of the PNS were assessed and import landmarks were analyzed and distance between the same was measured. These samples were analyzed and interpreted for the presence of anatomic variations.
- In this study, the samples distribution was 23 females and 17 males, of which <25 years were 13, 25- 45 years was 16 and >45 years was 11. Out of 40 CT Scans DNS was seen on right side with a mean of 6.79^0 and mean on left was 7.84^0.
- AEF studied from the nasal floor showed a mean of 4.51 mm on left side and 4.49 mm on right side. Similarly, AEF studied from the IOF showed a mean of 2.41mm on right side and left side 2.45mm.
- AES studied from IOF showed a mean of 3.43mm on right and left 3.45mm.
- Angle between LL and the CP showed a mean of 103.76^0 on right and 98.31^0 on left.
- The depth anterior $1/3^{rd}$ of OF was measured and showed no statistically significant difference was found amongst the genders and age groups. Similarly height of OF was calculated and measured and showed that Type II Keros was more in Females whereas Type I Keros was more predominantly seen in males.

- No statistically significant variation was observed in the LP when compared on either side of the CT scan, age groups and gender.
- Anatomical variations was observed in right and left sides were- Concha bullosa: right 40% and left 37.5%, Medialised Uncinate process: right 2.5% and left 5%, pneumatized uncinate process: right 0 and left 2.5%, supra orbital ethmoidal cell: right 67.5% and left 67.5%, presence of bony cover over anterior ethmoidal artery: right 85% on the Left 77.5% and the attachment of the uncinate process: Ethmoid roof : right 52.5 % and left 52.5%, Middle turbinate attachment- right 35% and left 35% and free end: right 12.5% and left 12.5% .
- Anatomical variations observed in in different age groups were- Concha bullosa: age groups <25: right 15% and left 15%, age 25-45 years right 15% and left 17.5%, age >45 right 10% left 5%), Medialised Uncinate process, (age groups <25: right 2.5% and left 2.5%, age 25-45 years right 0 and left 2.5%, age >45 right & left 0. pneumatized uncinate process (age <25 right 0 and left 2.5%, Age 25 – 45 right & left 0, >45 age right and left 0, supra orbital ethmoidal cell: age groups <25: right 20% and left 22.5%, age 25-45 years right 32.5% and left 30%, age >45 right 15% left 15%, pneumatized crista galli: age groups <25: 7.5%, age 25-45 years 12.5%, age >45 was 0. Presence of bony cover over anterior ethmoidal artery: age groups <25: right 27.5% and left 27.5%, age 25-45 years right 35% and left 30%, age >45 right 22.5% left 20%) and the attachment of the uncinate process: Ethmoid roof: age <25: Right 12.5% and Left 12.5%; age 25-45 years: right 22.5% and left 22.5% and age >45 right and eft 17.5% on both sides. Middle turbinate attachment: age <25: Right 15% and Left 15%; age 25-45 years: right 15% and left 15% and

age >45 right 5% and left 5%. Free end: age <25: Right 5% and Left 5%; age 25-45 years: right 2.5% and left 2.5% and age >45 right 5%and left 5%.

- Anatomical variation was observed among the genders were Concha bullosa: Right: female 39.1% and male 41.1% Left: Female 43.3% and male 29.4%, Medialised Uncinate process: Right: Female 4.3% and male 0, Left: Female 8.6% and male 0, pneumatized uncinate process: Right: Female and Male 0 and Left: Female 4.3% and male 0, supra orbital ethmoidal cell: Right: Female 69.5% and male 64.7%, Left: female 69.5% and male 64.7%, pneumatized crista galli: 13.04 % in females and 29.4% in males, presence of bony cover over anterior ethmoidal artery: right: Female 91.3% and male 76.4% Left: females 82.6% and right 70.5% and the attachment of the uncinate process: Ethmoid roof : right: female 43.4% and males 64.7% Left: females 30.4% and males 47%; Middle turbinate attachment: Right: female 43.4% and males 23.5% Left: female 43.4% and males 23.5%; free end: Right: female 13.04% and 23.5% in males; Left: females 26% and males 29.4% .

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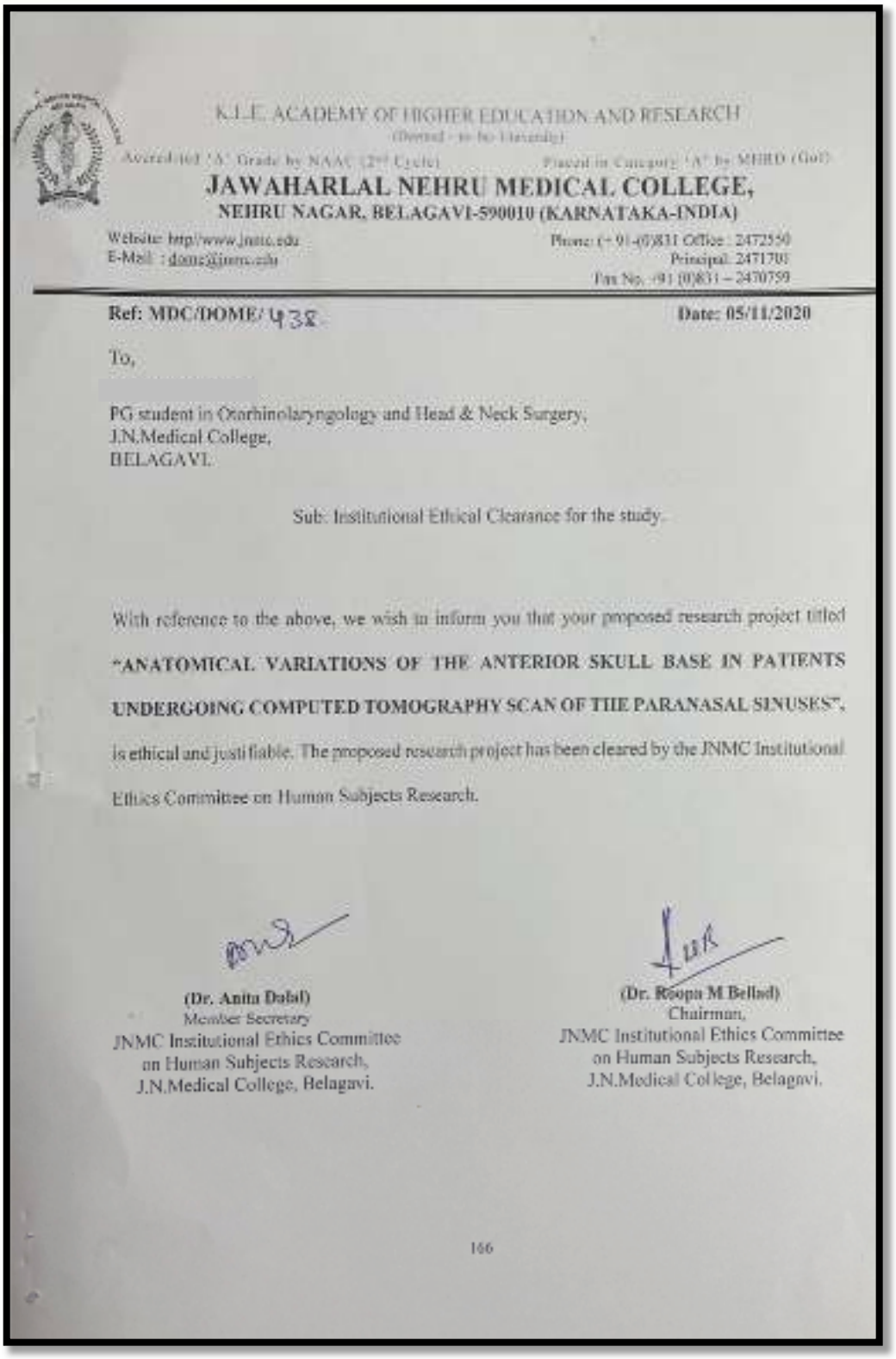
ANNEXURE 1

ETHICAL CLEARANCE CERTIFICATE



K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to - be - University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)

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Fax No. -91 (0)831 – 2470759

Ref: MDC/DOME/ 438 **Date: 05/11/2020**

To,

PG student in Otorhinolaryngology and Head & Neck Surgery,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"ANATOMICAL VARIATIONS OF THE ANTERIOR SKULL BASE IN PATIENTS UNDERGOING COMPUTED TOMOGRAPHY SCAN OF THE PARANASAL SINUSES"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

166

ANNEXURE II

PROFORMA FOR DATA COLLECTION

PROFORMA

ANATOMICAL VARIATIONS OF THE ANTERIOR SKULL BASE IN PATIENTS UNDERGOING COMPUTED TOMOGRAPHY SCAN OF THE PARANASAL SINUSES

Date: Scan no:

Name:

Age:

Sex:

CT PARANASAL SINUSES

Parameters:

Variation	Right	Left
Deviated nasal septum		
Concha Bullosa		
Medialised uncinate process		
Pneumatised uncinate process		
Supraorbital ethmoidal cell pneumatization		
Anterior ethmoidal foramen		
Anterior ethmoidal sulcus		
Pneumatised crista galli		

Attachment of the uncinated process		
Angle between lateral lamella and cribriform plate at level of AEA		
Anterior 1/3rd of olfactory fossa- 2mm behind anterior edge of crista galli		
Height of olfactory fossa		
Length of the olfactory fossa (Axial cuts)		
Bony cover of the anterior ethmoidal artery		
Lamina papyracea		

Lund Mackay Scoring:

Sinus	Right	Left
Frontal		
Anterior ethmoidal		
Posterior ethmoidal		
Maxillary		
Sphenoid		
Ostiomeatal complex		

ANNEXURE III - PHOTOGRAPHS

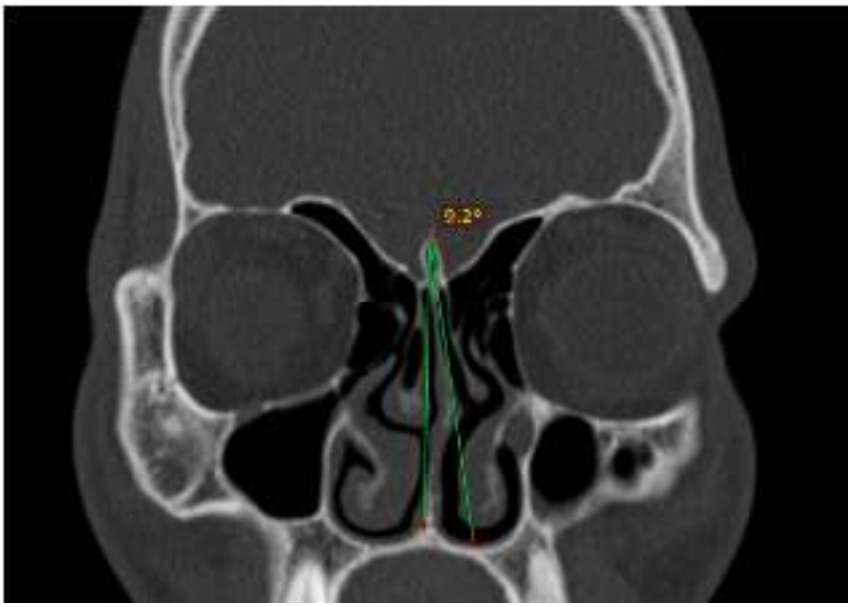

Image -1 **Measurement of the nasal septal deviation (Left Deviation of septum by 9.2^0)**

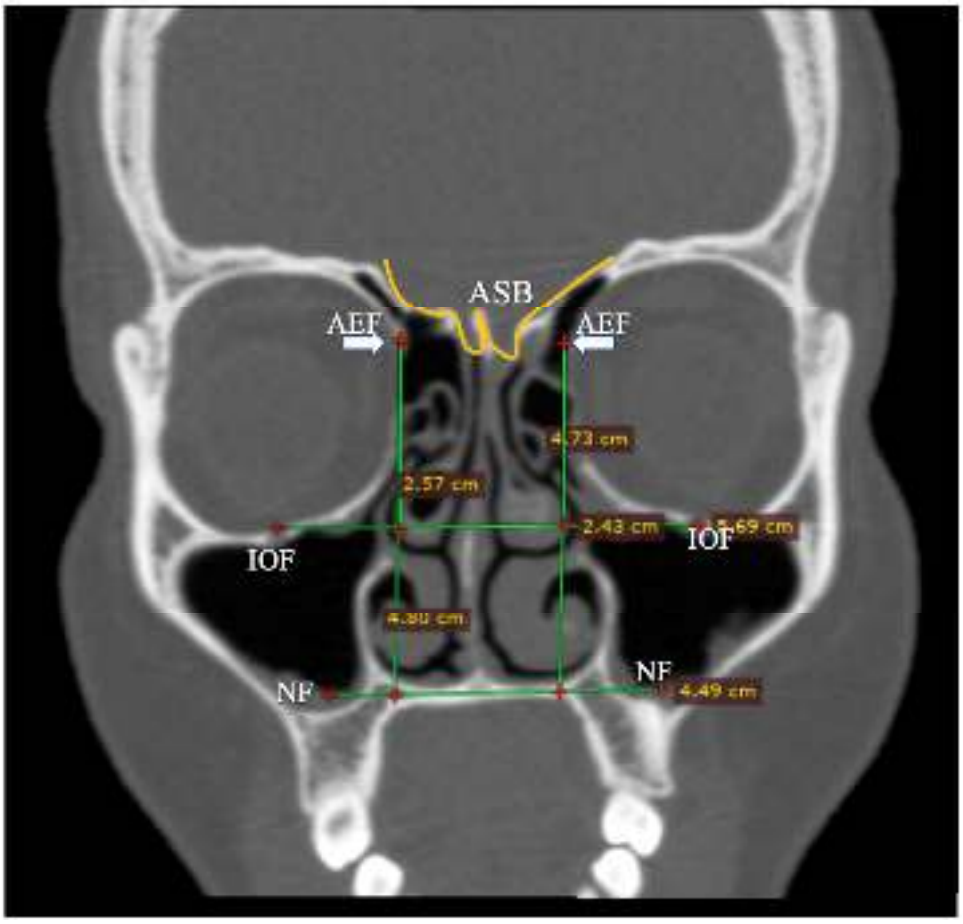

Image- 2 **Measurement of the anterior ethmoidal foramen from the nasal floor and infra orbital foramen.**

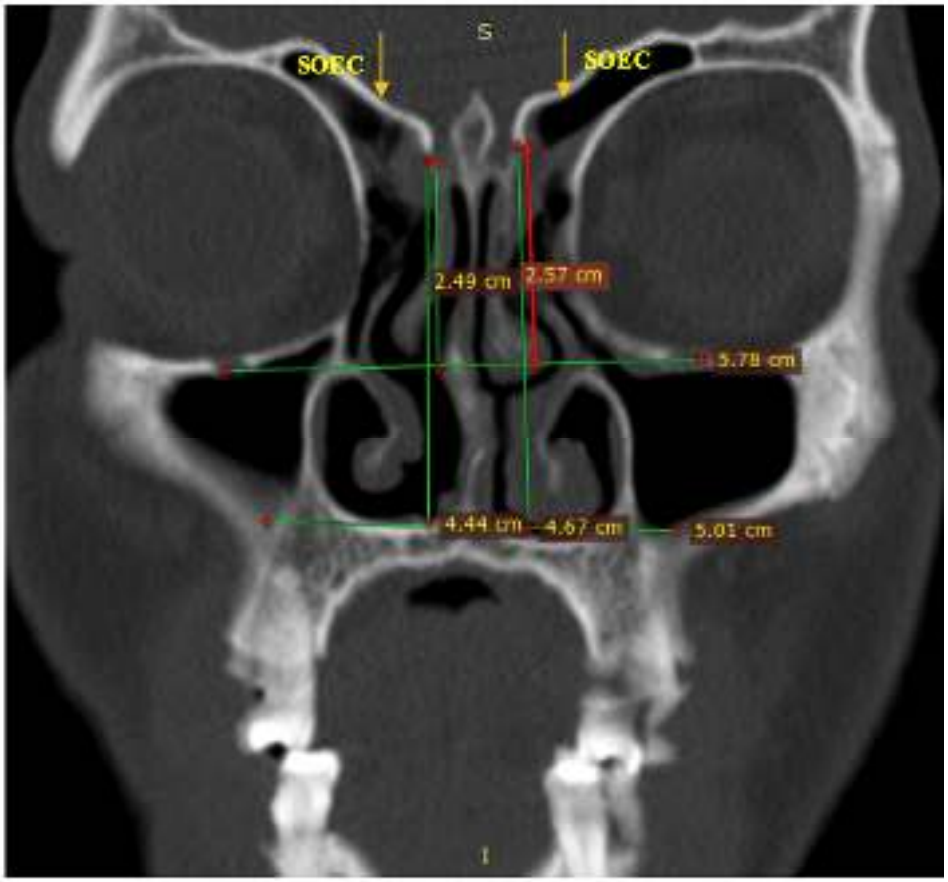

Image- 3 **Measurement of Anterior ethmoidal sulcus from the nasal floor and the Infra orbital foramen. SOEC (yellow arrows)**

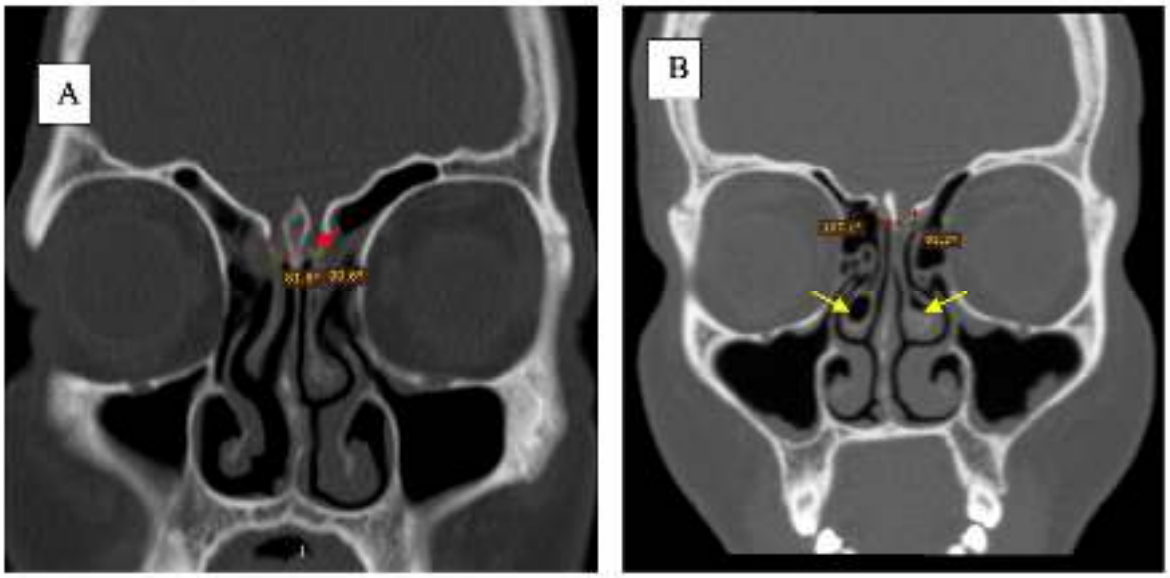

Image- 4 **Measurement of angle between the lateral lamella and cribriform plate (A & B)**

A- Pneumatized Crista galli show (red arrow)

B- Bilateral Concha bullosa (yellow arrows)

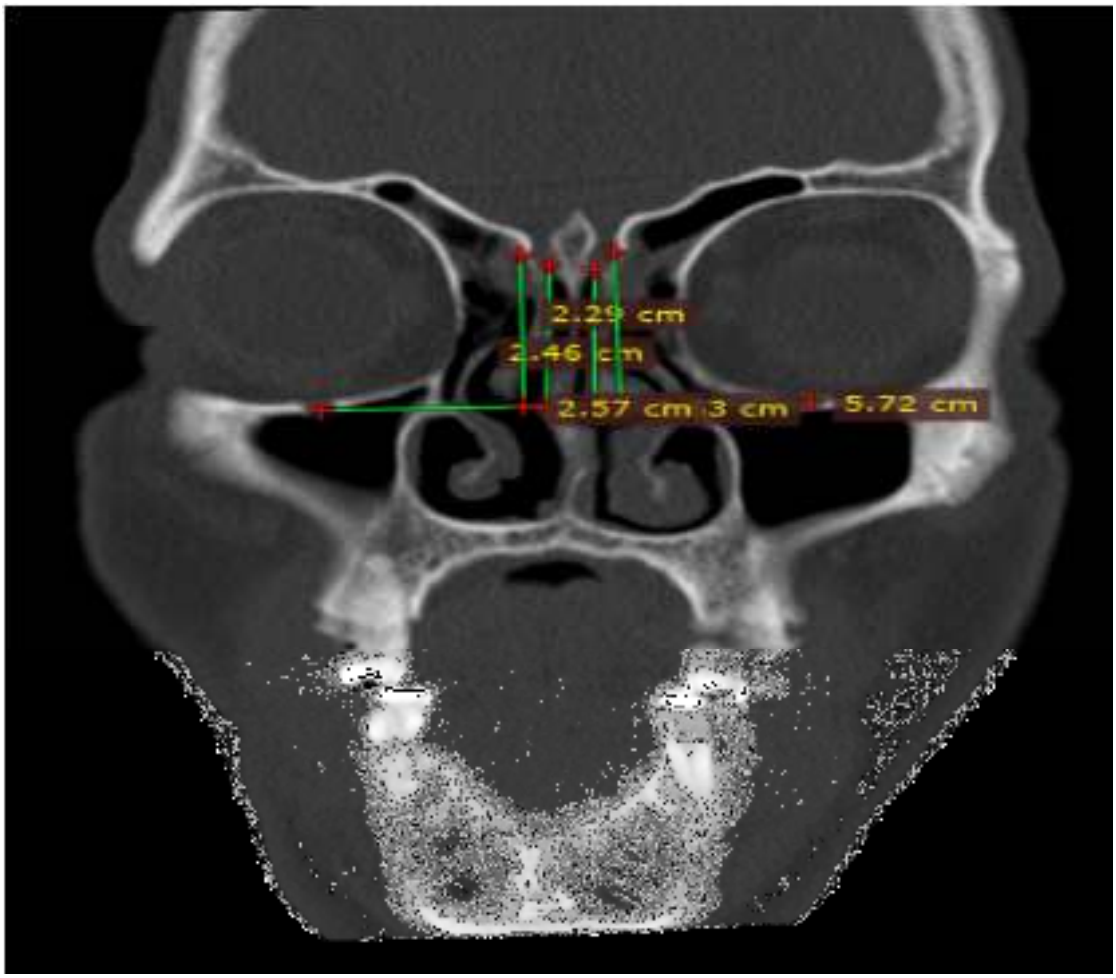

Image-5 **Measurement of the olfactory fossa depth- length of lateral lamella measured and subtracted from the length of the cribriform plate**

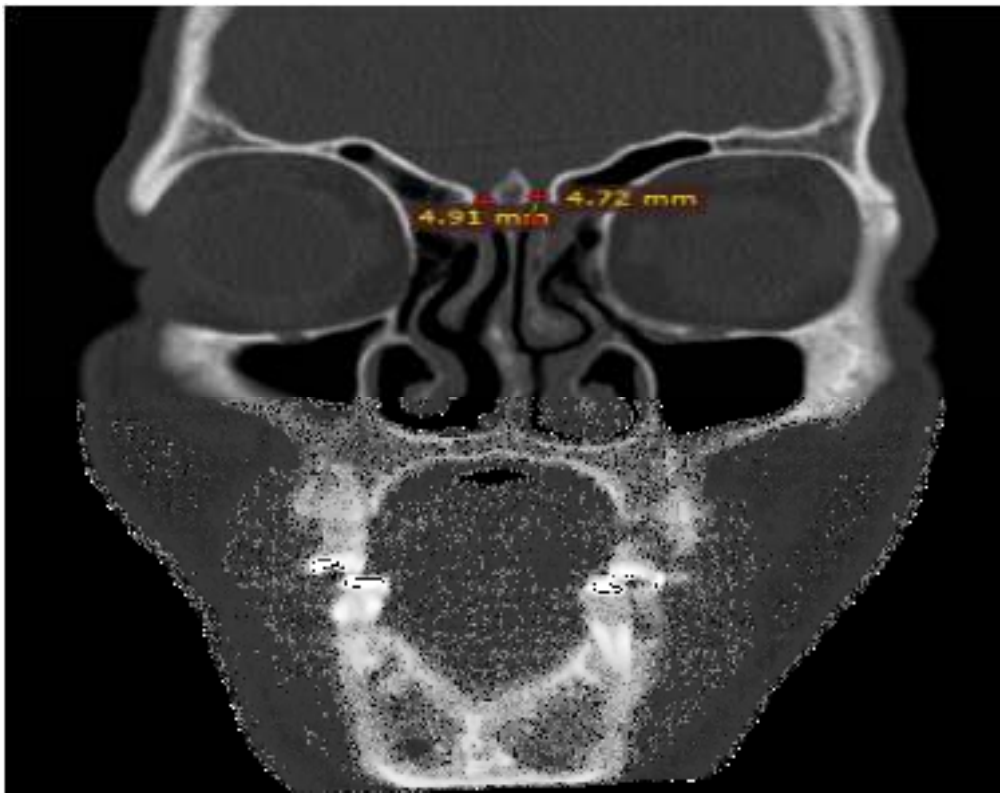

Image- 6 **Measurement of the height of olfactory fossa**

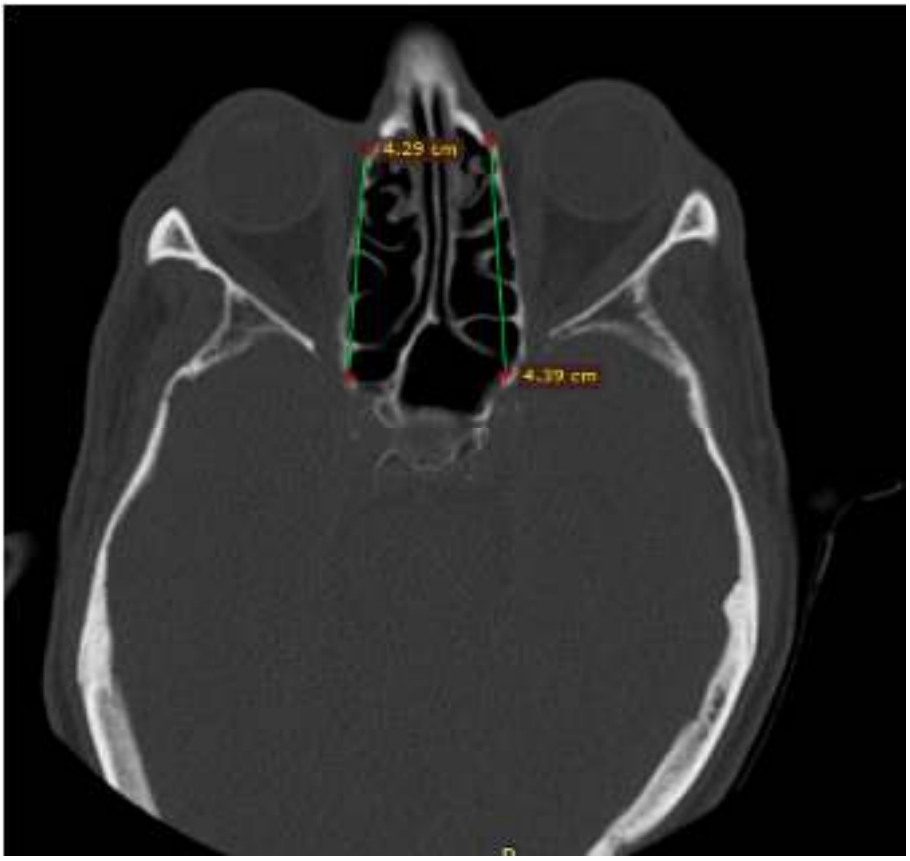

Image-7 **Length of lamina papyracea**

ANNEXURE IV

KEY TO MASTER CHART

Age- in years

Sex- Male & Female

Deviated nasal Septum (DNS)- Right and Left in degrees

Anterior Ethmoidal Foramen (AEF)- measured from nasal floor (NF)

- Right & Left in cm Measured from infra orbital foramen (IOF)
- Right & Left in cm

Pneumatized crista galli: Right & Left- Present or No

Uncinate attachment: Ethmoid roof, free, middle turbinate

Angle between lateral lamella & cribriform plate- Right & Left- Degrees

Height of olfactory fossa Anterior 1/3rd - Right & Left- mm

Height of Olfactory fossa: Right & Left- mm

Keros: Type I – 1- 3 mm

Type II – 4 - 7mm

Type III – 8 – 11 mm

Length of Olfactory fossa: Right & Left- cm

Bony cover over anterior Ethmoidal artery (AEA): Right & Left- Present or No

Length of Lamina Papyracea: Right & Left- cm

Lund Mackay scoring – Right & Left- 0, 1, 2

Sl.No	Name	Age	Sex	DEVIATED NASAL SEPTUM		CONCHA BULLOSA		Medialised Uncinate Process		Pneumatised Uncinate Process		Supra orbital Ethmoidal cell		Anterior Ethmoidal foramen (NF)		Anterior Ethmoidal formen (fOF)		Anterior ethmoidal suleus (fOF)		Pneumatised Crista Galli	Uncinate attachment		Angle between lateral lamella & cribriform plate at level of AEA		Anterior 1/3rd of olfactory fossa		Height of olfactory fossa (MERP) cm		Heigth of olfactory fossa (LLCP) cm		HEIGHT (mm)		HEIGHT(mm)		KEROS		KEROS		Length of olfactory fossa		Bony cover over anterior ethmoidal artery		Lamina papyracea		Anterior nasal spine to sella turcica	LUND	
																																											Total	Total
				Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left		Right	Left
1	RAMAPPA V	36	M	3.7		No	No	No	No	No	No	PRESENT	PRESENT	4.6	4.5	2.4	2.6	2.3	2.45	no	ETHMOID ROOF	ETHMOID ROOF	110	108	4	3.79	2.09	2.07	1.76	1.7	**3.3**	**3.7**	**II**	**II**	3	3.79	Present	Present	3.08	3.3	7.12	**1**	**0**
2	KAMALA PATIL	60	F	8.2		PRESENT	NO	No	No	No	No	NO	NO	4.69	4.54	2.37	2.45	2.32	2.45	NO	ETHMOID ROOF	ETHMOID ROOF	119.6	120	4.22	4.4	2.09	2.07	1.76	1.75	**3.3**	**3.2**	**II**	**II**	4.22	4.4	Present	Present	3.08	3.3	7.2	**1**	**0**
3	NIRMALA KULKARNI	58	F		10.4	NO	No	No	No	No	No	PRESENT	PRESENT	4.63	4.73	2.06	2.1	5.07	5.05	NO	MIDDLE TURBINATE	MIDDLE TURBINATE	52.8	64.7	3.25	3.73	2.06	2.04	2.36	2.25	**3**	**2.1**	**I**	**I**	3.25	3.73	Present	NO	3.26	3.26	7.48	**3**	**3**
4	MADHU KADGONKAR	21	F	4.3		PRESENT	No	No	No	No	PRESENT	PRESENT	PRESENT	4.42	4.37	2.25	2.22	2.66	2.9	no	MIDDLE TURBINATE	MIDDLE TURBINATE	110	107	3.78	3.68	2.28	2.27	2.68	2.65	**4**	**3.8**	**II**	**II**	3.78	3.68	Present	Present	2.41	2.81	7.14	**0**	**1**
5	MADHU AKKI	27	F	9.5		No	PRESENT	No	No	No	No	NO	NO	4.12	4.22	2.44	2.56	4.29	4.22	no	MIDDLE TURBINATE	MIDDLE TURBINATE	118.4	130	4.86	3.44	2.7	2.63	2.43	2.41	**2.7**	**2.2**	**I**	**I**	4.86	3.44	Present	Present	4.09	4.19	7.31	**2**	**1**
6	KAMALA DESAI	39	F	9.6		No	No	No	No	No	No	PRESENT	PRESENT	4.42	4.16	2.46	2.14	4.16	4.03	no	MIDDLE TURBINATE	MIDDLE TURBINATE	124.7	140	3.63	4.8	2.45	2.26	2.26	2.1	**1.9**	**1.6**	**I**	**I**	3.63	4.8	Present	Present	3.28	3.81	5.78	**1**	**2**
7	JAYA VARAL	34	F	4.4		PRESENT	PRESENT	No	PRESENT	No	No	PRESENT	PRESENT	4.8	4.68	2.57	2.43	4.98	4.98	PRESENT	MIDDLE TURBINATE	MIDDLE TURBINATE	107	92	2.99	2.65	2.7	2.62	2.53	2.4	**1.7**	**2.2**	**I**	**I**	2.99	2.65	Present	Present	3.68	3.93	7.62	**0**	**0**
8	IRAYYA KEMPAYYA	52	M		4.9	No	No	No	No	No	No	NO	NO	4.8	4.68	2.57	2.4	4.8	4.8	no	ETHMOID ROOF	ETHMOID ROOF	109	100	3.2	3.6	2.03	2.2	2.7	2.89	**6.7**	**6.9**	**II**	**II**	3.2	3.6	Present	Present	3.29	3.99	7.23	**2**	**2**
9	GANESH SHETTY	21	M	6		NO	NO	NO	NO	NO	NO	PRESENT	PRESENT	4.84	4.75	2.59	2.63	2.24	2.19	NO	ETHMOID ROOF	ETHMOID ROOF	122.9	117	3.3	4.06	2.7	2.72	2.2	2.2	**5**	**5.2**	**II**	**II**	3.3	4.06	No	NO	4.31	4.9	7.46	**0**	**0**
10	DURGAPPA PUJARI	65	M	7.5		No	No	No	No	No	No	NO	NO	4.1	4.23	2.7	2.89	3.97	3.9	no	FREE	FREE	118	107	4.6	4.7	2.01	2.06	2.79	2.86	**7.8**	**8**	**II**	**III**	4.6	4.7	Present	Present	3.46	3.78	6.96	**0**	**0**
11	SADIK KHAN	18	M		9.2	PRESENT	NO	NO	NO	NO	NO	PRESENT	PRESENT	4.5	5	2.57	2.68	2.3	2.92	PRESENT	MIDDLE TURBINATE	MIDDLE TURBINATE	128	108	3.52	3.1	2.31	2.41	2.86	2.99	**5.5**	**5.8**	**II**	**II**	3.52	3.1	PRESENT	PRESENT	4.08	3.95	6.01	**2**	**2**
12	VISHAL PATIL	21	M		3.2	PRESENT	PRESENT	NO	NO	NO	NO	PRESENT	PRESENT	4.5	4.5	2.7	2.1	2.4	2.39	NO	ETHMOID ROOF	ETHMOID ROOF	99	97	4.03	4.18	2.14	2.13	2.42	2.36	**2.8**	**2.3**	**I**	**I**	4.03	4.18	PRESENT	PRESENT	4.34	4.3	7.27	**4**	**4**
13	CHANAPPA HOLEYACHI	31	M	7.9		No	No	No	No	No	No	PRESENT	PRESENT	4.73	4.77	2.39	2.35	4.69	4.69	NO	MIDDLE TURBINATE	MIDDLE TURBINATE	90.6	130	4.37	4.34	2.17	2.15	2.53	2.54	**3.6**	**3.9**	**II**	**II**	4.37	4.34	Present	Present	3.18	3.31	7.94	**0**	**2**
14	LEELA SANADI	38	F	6		No	No	No	No	NO	No	PRESENT	PRESENT	4.6	4.5	2.18	2.11	2.42	2.36	no	ETHMOID ROOF	ETHMOID ROOF	98.3	94.7	4.03	4.18	2.14	2.13	2.36	2.42	**2.2**	**2.9**	**I**	**I**	4.03	4.18	Present	Present	4.34	4.34	7.65	**7**	**6**
15	BASAPPA BELAKOPPAD	43	M		10	No	PRESENT	No	No	No	No	PRESENT	PRESENT	4.43	4.6	2.45	2.6	2.55	2.6	PRESENT	ETHMOID ROOF	ETHMOID ROOF	115.5	78.7	3.53	4.37	2.28	2.22	2.47	2.56	**1.9**	**3.4**	**I**	**II**	3.53	4.37	NO	NO	3.54	3.18	7.31	**9**	**5**
16	SUNITA SREENATH	50	F	2		No	No	No	No	No	No	NO	NO	4.16	4.58	2.48	2.68	2.79	2.83	no	ETHMOID ROOF	ETHMOID ROOF	128.9	100	3.65	3.37	2.16	2.27	2.13	2.06	**0.3**	**2.1**	**I**	**I**	3.65	3.37	No	NO	3.89	3.35	7.26	**7**	**4**
17	MOHIT	25	M		3	PRESENT	No	No	No	No	No	PRESENT	PRESENT	5.1	5.1	2.35	2.45	5.04	5.04	PRESENT	ETHMOID ROOF	ETHMOID ROOF	76.7	65	5.67	5.47	2.09	2.09	2.39	2.47	**3**	**3.8**	**I**	**II**	5.67	5.47	Present	NO	4.04	3.88	7.46	**2**	**0**
18	SAVITA JADHAV	43	F	10.5		PRESENT	No	No	No	No	No	PRESENT	NO	4.46	4.43	2.32	2.45	4.36	4.37	no	FREE	FREE	97	75	3.63	3.43	2.48	2.54	2.7	2.73	**2.2**	**1.9**	**I**	**I**	3.64	3.46	Present	NO	3.13	3.34	7.07	**1**	**2**
19	SAMBHAJI	41	M		5.3	No	No	No	No	No	No	PRESENT	PRESENT	4.93	4.66	2.28	2.2	4.64	4.6	PRESENT	MIDDLE TURBINATE	MIDDLE TURBINATE	120	86.8	4.36	3.3	2.36	2.4	2.8	2.59	**4.4**	**1.9**	**II**	**I**	4.36	3.35	Present	Present	4.11	3.85	7.15	**0**	**0**
20	SHIRALINGAPPA	53	M	2		PRESENT	PRESENT	No	No	No	No	NO	NO	4.93	4.91	2.85	3.01	3.05	3.17	no	FREE	FREE	72.6	100	2	1.87	2.88	2.99	3.05	3.09	**6.2**	**1**	**II**	**I**	2	1.87	No	NO	3.77	3.56	8.01	**0**	**0**
21	ASHWINI CHANDRA	21	F		6	No	No	PRESENT	PRESENT	No	No	PRESENT	PRESENT	4.32	4.19	2.41	2.49	4.56	4.39	PRESENT	FREE	FREE	119	81	3.96	3.8	2.89	2.89	2.4	2.4	**4.9**	**4.9**	**II**	**II**	3.96	3.8	No	NO	4.01	4	7.52	**2**	**2**
22	GANAPATI KOPPAD	60	M	7.2		No	No	No	No	No	No	PRESENT	PRESENT	4.16	4.26	2.12	2.21	2.49	2.57	no	MIDDLE TURBINATE	MIDDLE TURBINATE	81.8	90.6	4.91	4.72	2.57	2.63	2.46	2.29	**1.1**	**3.4**	**I**	**II**	4.91	4.72	Present	Present	4.29	4.39	6.93	**0**	**0**
23	VANISHRI MEDAR	21	F	5.8		PRESENT	PRESENT	No	No	No	No	PRESENT	PRESENT	4.42	4.37	2.25	2.22	2.66	2.59	no	MIDDLE TURBINATE	MIDDLE TURBINATE	120	102	3.78	3.68	2.28	2.27	2.68	2.65	**4**	**3.8**	**II**	**II**	3.78	3.68	Present	Present	2.41	2.81	7.31	**0**	**1**
24	USHA WALVEKAR	58	F		11.9	No	No	No	No	No	No	PRESENT	PRESENT	4.31	4.37	2.37	2.43	2.47	2.45	no	ETHMOID ROOF	ETHMOID ROOF	118	110	2.76	3.09	2.76	3.09	2.68	2.65	**1**	**4.4**	**I**	**II**	3.76	3.78	Present	Present	3.33	3.14	7.8	**0**	**0**
25	SUSHILABAI PATIL	65	F	10		PRESENT	PRESENT	No	No	No	No	PRESENT	PRESENT	4.32	4.19	2.41	2.49	4.5	4.3	no	ETHMOID ROOF	ETHMOID ROOF	128	108	4.17	4.03	2.3	2.4	2.7	2.8	**4**	**4**	**II**	**II**	4.17	4.08	Present	Present	4.1	4.03	7.2	**2**	**2**
26	PREETHI DHARENNAVAR	18	F	6.5		No	No	No	No	No	No	PRESENT	PRESENT	4.56	4.83	2.16	2.38	4.82	4.75	no	MIDDLE TURBINATE	MIDDLE TURBINATE	117	94.7	5.26	5.23	2.23	2.26	2.56	2.4	**3.3**	**1.4**	**II**	**I**	5.26	5.23	Present	Present	3.4	3.15	7.06	**0**	**0**
27	SANGEETA KATTI	47	M		8.6	PRESENT	No	No	No	No	No	PRESENT	PRESENT	4.45	4.51	2.54	2.65	4.57	4.78	no	ETHMOID ROOF	ETHMOID ROOF	117	123	3.9	3.7	2.01	2.13	2.46	2.62	**4.5**	**4.9**	**II**	**II**	3.9	3.71	Present	Present	3.79	4.28	6.96	**0**	**0**
28	SAMEER PASHA	22	M		4	PRESENT	PRESENT	No	No	No	No	NO	PRESENT	4.68	4.73	2.62	2.69	4.66	4.77	no	ETHMOID ROOF	ETHMOID ROOF	80	59	4.82	4.62	1.93	1.87	2.37	2.25	**4.4**	**3.8**	**II**	**II**	4.82	4.62	Present	Present	3.78	3.35	8.3	**1**	**1**
29	PRASSANNA KUMAR BADI	25	M	4.9		No	PRESENT	No	No	No	No	PRESENT	NO	4.42	4.61	2.37	2.5	4.62	4.61	no	ETHMOID ROOF	ETHMOID ROOF	118.7	99	3.82	3.48	2.33	2.4	2.54	2.75	**2.1**	**3.5**	**I**	**II**	3.82	3.48	No	NO	2.78	2.84	7.3	**0**	**2**
30	SWETA DALVI	35	F	9		PRESENT	PRESENT	No	No	No	No	NO	PRESENT	4.2	4.16	2.2	2.16	2.3	2.2	no	ETHMOID ROOF	ETHMOID ROOF	99	100	4.5	4.5	2	2.1	2.21	2.2	**0.2**	**0.1**	**I**	**I**	4	4	Present	Present	4.03	3.58	7.26	**4**	**0**
31	SHRISTI AGARWAL	21	F	9		No	PRESENT	No	No	No	No	PRESENT	PRESENT	4.2	4.17	2.13	2.1	2.24	2.29	NO	ETHMOID ROOF	ETHMOID ROOF	48	79	4.49	0.01	1.79	1.78	2.21	2.22	**4.2**	**4.4**	**II**	**II**	4.49	5.01	Present	Present	3.93	3.68	7.23	**1**	**2**
32	SUREKHA BHOGAN	40	F	4		No	No	No	No	No	No	PRESENT	PRESENT	4.31	4.3	2.6	2.67	4	4	no	ETHMOID ROOF	ETHMOID ROOF	100	117	3.76	3.7	1.76	1.8	2.2	2.2	**4.4**	**4**	**II**	**II**	3.76	3.7	Present	Present	2.75	3.13	7.21	**0**	**0**
33	SUDHIR	35	M		10.4	No	No	No	No	No	No	NO	NO	4.42	4.37	2.76	2.8	4.01	3.99	no	ETHMOID ROOF	ETHMOID ROOF	107	117	3.8	3.96	2.01	1.96	2.25	2.25	**2.4**	**2.9**	**I**	**I**	3.8	3.96	Present	Present	2.99	3.25	7.06	**2**	**0**
34	KEERTI MOLAGE	24	F	8.1		No	PRESENT	No	No	No	No	NO	NO	4.9	4.98	2.33	2.33	2.16	2.18	no	MIDDLE TURBINATE	MIDDLE TURBINATE	76	87.2	4.1	4,34	2,07	2.13	2.33	2.3	**2.6**	**1.7**	**I**	**I**	4.1	4.34	Present	Present	3	3.58	7.25	**3**	**1**
35	SUHAS NAVAJKAR	22	M		16	PRESENT	No	No	No	No	No	NO	NO	5.06	5.16	2.37	2.49	2.49	2.6	PRESENT	ETHMOID ROOF	ETHMOID ROOF	111	102	5.3	4.98	2.21	2.19	2.41	2.56	**2**	**3.7**	**I**	**II**	5.3	4.99	Present	Present	3.21	3.57	8	**0**	**0**
36	SULTANAMMA DALAYAR	24	F		7.7	No	No	No	No	No	No	NO	NO	4.31	4.31	2.25	2.18	2.19	2.14	no	MIDDLE TURBINATE	MIDDLE TURBINATE	122	80	4.19	4.19	1.77	1.86	2.12	2.21	**3.5**	**3.5**	**II**	**II**	4.19	4.19	Present	Present	3.76	3.98	7.54	**2**	**2**
37	SONAM DHONGADI	35	F	10.8		PRESENT	PRESENT	NO	NO	NO	NO	PRESENT	PRESENT	4.54	4.56	2.08	2.19	2.33	2.29	PRESENT	ETHMOID ROOF	ETHMOID ROOF	95.9	102	4.06	2.92	2.04	2	2.33	2.29	**2.9**	**2.9**	**I**	**I**	4.06	2.92	Present	Present	3.18	3.08	7.1	**0**	**0**
38	SUNANDA GINDE	50	F		7	No	No	No	No	No	No	PRESENT	PRESENT	4.11	4.08	2.38	2.35	2.22	2.26	no	ETHMOID ROOF	ETHMOID ROOF	76	62.7	3.71	3.56	2.02	2.06	2.22	2.26	**2**	**2**	**I**	**I**	3.71	3.56	Present	Present	3.36	3.37	6.75	**6**	**6**
39	RADHIKA NAYAK	18	F	8.6		No	PRESENT	No	No	No	No	NO	NO	4.31	4.4	2.36	2.9	3.96	4	no	FREE	FREE	88	98	3.6	3.9	2.21	2.01	2.7	2.99	**4.9**	**9.8**	**II**	**III**	3.6	3.9	Present	Present	3.78	3.89	7.77	**0**	**0**
40	ZEBA JAMEDAR	29	F	4.3		PRESENT	PRESENT	No	No	No	No	PRESENT	PRESENT	4.01	4.07	2.78	2.89	2.99	3.01	no	MIDDLE TURBINATE	MIDDLE TURBINATE	109	100	3.6	3.9	1.89	1.9	2.8	2.9	**9.1**	**10**	**III**	**III**	3.6	3.9	Present	Present	3.77	3.6	7.53	**0**	**0**