"ANATOMICAL AND RADIOLOGICAL CORRELATION OF MASTOID AIR CELLS SYSTEM IN RELATION TO ITS MORPHOLOGY"

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ACCEPTANCE LETTER

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LIST OF ABBREVATIONS

EAC	External auditory canal
SP	Styloid process
MACS	Mastoid air cell system
ET	Eustachian tube
ME	Middle ear
TM	Tympanic membrane
MACS	Mastoid air cell system

ABSTRACT

Background:A Cadaveric study of 30 Temporal bone in which the Mastoid air cell system has been studies in relation with radiological X-ray and morphological features. This is one of a kind study in which radiological and anatomical co relation has been done. The Mastoid air cell system has shown to have anatomical variations in its associated structures and also varied pneumatization pattern and its co-relation with middle ear structures. Therefore necessitating a need for radiological digital X-ray assessment of the mastoid air cell system with dissection (Cortical Mastoidectomy) and post dissection digital X-ray .

Objectives: The objective of the study is to determine the profile of variation in mastoid air cell system and its related morphology in pre-dissection radiograph , dissection findings and post dissection radiograph .

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.

30 cadaveric temporal bones were studied and measurements were taken to measure all the parameters as per the proforma and the anatomical and radiological co-relation between the vital structures were carried out. All measurements were recorded and photographs were documented.

FINDINGS: 13 Left & 17 Right temporal bones were studied. Different measurements were studied and compared between its morphology and right and left sides.

RESULT: Out of 30 temporal bones ,15 were pneumatic (50 %) , diploic were 7 (23.33 %) , sclerotic 8 (26.67 %)

Mean of surface area of mastoid air cell in pre dissection x-ray was 2.84 +/- 0.71, in post dissection x-ray was 3.07 +/- 0.71 and in anatomical dissection method was3.04 +/- 0.71.

Mean Shortest length between sigmoid sinus and posterior wall of EAC in pre dissection x-ray was 20.27 +/- 3.0, anatomical dissection method was 21.57 +/- 3.04 , in post dissection x-ray was 21.63 +/- 2.75 .

In pre dissection x-ray the mean of Shortest distance between dural plate and astoid tip was 20.67 +/- 3.34 , in anatomical dissection method was 20.90+/- 3.33 , in post dissection x-ray was 22.40 +/- 3.02.

CONCLUSION: With a rapid increase in the need for mastoid 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 mastoid air cell system dynamics.

Key words- Mastoid air cell system , sigmoid sinus , dural plate, EAC , cortical mastoidectomy .

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INTRODUCTION

A thorough knowledge of anatomy is an indispensable requirement for any surgery, regardless of the specialty. When it comes to the microscopic intricately detailed temporal bone anatomy, it is often seen to require a set of skilled eyes to understand the correct anatomy and its variances.

The evaluation and understanding of the size and distribution of air cells in the human ear has been shown to be of considerable surgical importance [1]. These air cells are distributed throughout the temporal bone, there presence and number vary with degree of pneumatization, but, are unequivocally present in the mastoid process.

The Mastoid process is a conical projection on the temporal bone, which is vital for the normal physiological functioning of the middle ear apparatus. It consists of a group of air-filled mucosa lined bony cavities, that maintains the pressure homeostasis of the tympanic cavity, thus has been aptly referred to as the air reservoir of middle ear cleft. This brings to light the importance of the volumetric properties of the mastoid air cell system and the need to investigate them.[1,2]

The function of mastoid air cell system is to perform gas exchange, which is maintained even in the absence of a normally functioning eustachian tube. Like alveoli of the lung, mucosa of the air cell of mastoid performs function of gas exchange thus total surface area of mucosa determines the rate of gas exchange. As the mastoid air cell system is made up of several exceedingly irregular air-filled spaces, measuring the entire surface area of air cells will be a non-viable and impractical effort. The development of a convenient parameter to measure the mucosal surface area will be a useful metric in the physiological investigation of the air cell system of the mastoid system.[3]

X-ray mastoid Schullers view is one of the basic and most easily available and cost effective method of radiological evaluation of mastoid air cell system. It is widely used amongst otologist in the pre operative evaluation as well as post operative evaluation of mastoid air cell system. It not only provides details of the pneumatization pattern of mastoid air cell system but also that of the important surgical landmarks , which are of extreme significance intraoperatively such as the dural plate , sigmoid sinus , sino-dural angle. So far no such studies have been conducted to study the correlation between the mastoid air cell system on a X-ray and cadaveric dissection method. This study aims to fill the lacunae in understanding the morphology of mastoid air cell system in relation to its vital structures both on X-ray and cadaver, helping to create a road map for mastoid surgeries.

In this study, we performed cadaveric dissection of the temporal bone, to study the anatomical measures of mastoid cavity and compared morphological results with the radiological measurements by using an X-ray mastoid. The pre-dissection measurements obtained using digital radiograph were compared to a post dissection digital radiographic measures and the post-dissection (cortical mastoidectomy) measurements obtained using a vernier calliper.

Clinical importance of this study is to assess the anatomical variations which are to be picked up on basic investigation like x-ray and prevent intra operative complications like injury to dura , sigmoid sinus , facial nerve , ossicles , semicircular canals .

The deficiency of radiological correlation by x-ray of air cell system of mastoid with anatomical dissection parameters makes this study of utmost importance. This study will help the surgeon for pre operative analysis of the condition of air cell system of the mastoid cavity, which is not yet done in India.

OBJECTIVE

Correlation of air cell system of mastoid air cell system radiologically and anatomically in association to its morphology in a cadaveric bone.

REVIEW OF LITERATURE

Because of its various embryological origins and unfavourable developmental features, one among the most important and challenging bones in human body is Temporal bone.[1]

The mastoid cavity has long been thought of as an air reservoir. The physiological features of the mastoid air cells have been examined primarily from a volumetric perspective.[4]

It is well known that the middle ear's regular air cell system can execute gas exchange without the help of the Eustachian tube.

EMBRYOLOGY

Temporal bone formation is an important aspect of the skull growth process because it is a portion of the skull.

The human skull is made up of three parts:

1.The cartilaginous neurocranium, also known as the chondrocranium, is a component of the skull that is created by endochondral ossification and makes up the majority of the base of the skull (ethmoid bone and portions of occipital, temporal, and sphenoid bone).Chondroblasts becomes hypertrophied and eventually transform into osteoblasts, which are responsible for the formation of the bone matrix, during endochondral ossification in a cartilaginous portion.[3]

2. The membraneous neurocranium, also known as the neuro-skull, which is vault of skull, created by intramembranous ossification (frontal and parietal portions of the temporal, occipital, sphenoid bone).

When there is no cartilaginous matrix, intramembranous ossification occurs. Osteoblasts are formed when a membranous structure contains a cluster of mesenchymal cells.

3.The viscerocranium, also known as the visceroskull, The branchial arches are connected to the rest of the cranium via this part of the skull. It consists of the facial bones .[4]

Cartilaginous neurocranium provides the deep part of petrous bone, whereas membranous neurocranium provides the more superficial parts.

The petrous part, squamous part , tympanic part , and styloid part fuse together to produce the temporal bone.

TEMPORAL BONE ANATOMY

Petrous is toughest bone in human skull, and its name comes from Latin word "petra," which means "rock." Inner ear, ICA , FC and majority of middle ear are all housed within it. The petrous bone is pyramid-shaped, projecting anteromedially at a 45 degree angle to transverse axis. Located in middle of basiocciput and sphenoid's greater wing. It has an endocranial anterosuperior surface, and it helps to construct the floor of the middle cranial fossa. Antero-lateral wall of posterior cranial fossa forms posterosuperior surface of it, which is likewise endocranial. Exocranial part makes inferior surface which corresponds to mastoid process's postero-medial section.[3]

Squamous bone makes up the majority of the temporal bone's lateral surface and is divided into two sections: vertical and horizontal:

Vertical section is a flat, thin bone plate that extends up to form a section of middle cranial fossa's lateral wall.

Zygomatic process extends anteriorly from the horizontal portion.[3]

Temporal bone's tympanic part is a drain-shaped plate of bone . Between glenoid fossa in front and mastoid process in the back, it is located beneath the squamous bone. Vaginal process is a plate of bone which is on the lower surface of the tympanic bone. It covers SP and joins with petrous bone near carotid canal. Anterior, inferior, and posterior walls of bony EAC are formed by tympanic bone.Two suture lines are defined by their connection to the mastoid part and squamous part : anterosuperiorly, the tympanosquamous suture, and posteroinferiorly, the tympanomastoid suture. Petrotympanic fissure is formed when petrous bone and tympanic bone articulate in middle.

Styloid Process is a bone that is elongated, thin, and sharp that is 20 to 25 mm in length. Stylomastoid foramen is anteromedial to it.

Styloid bone's tip is located between external and IAC, laterally placed to pharyngeal wall, and directly beyond tonsillar fossa. Styloid process is attatched by three muscles and two ligaments:namely Stylopharyngeus muscle, Styloglossus muscles, Stylohyoid muscles.[5]

Stylohyoid ligament and Stylomandibular ligament are two ligaments that connect the jaw to the skull.

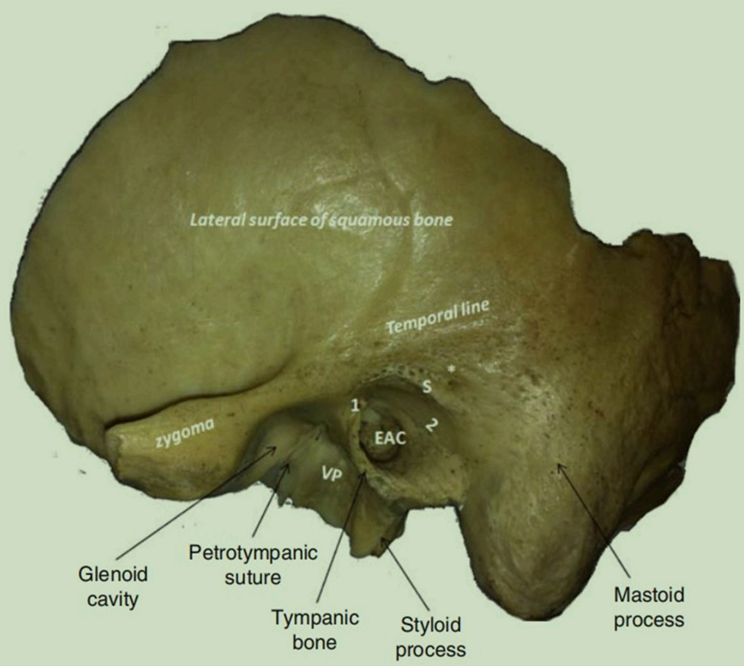


Fig. 1.12 Lateral surface of a left temporal bone. *1* tympanosquamous fissure, *2* tympanomastoid fissure, *EAC* external auditory canal, *S* Henle's spine, * suprameatal triangle, *VP* vaginal process

Fig 1 Temporal bone exhibits 4 surfaces: , Superior, lateral, inferior , posterior surface.

The bulk of lateral aspect of temporal bone is squamous part, which continues up as a flat bone to shield a section of temporal lobe of the cerebrum. Temporalis muscle attaches to the lateral surface of the squamaous part. The middle temporal artery is located in a vertical groove. Branches of middle meningeal artery are grooved into medial surface of squamous portion. Anterior, posterior, inferior walls of bony EAC are formed of tympanic bone. Notch of rivinus relates to gap between tympanic and squamous bones.Temporomandibular joint is placed anterior to EAC.[6]

Lateral side of temporal bone is marked by many significant landmarks:

Mastoid process

Zygomatic process

Superficial temporal line

Spine of henle

Suprameateal Mc Evan’s triangle

Petrous section of temporal bone is the only one that forms the rear surface. It symbolises the posterior cerebral fossa's anterolateral wall. Internal auditory meatus, which lies halfway between apex and anterior border of sigmoid sulcus on posterior surface, is most essential characteristic of this surface. Endolymphatic sac, which is medial to level of posterior semicircular canal which is an important structure.

(Fig 2).

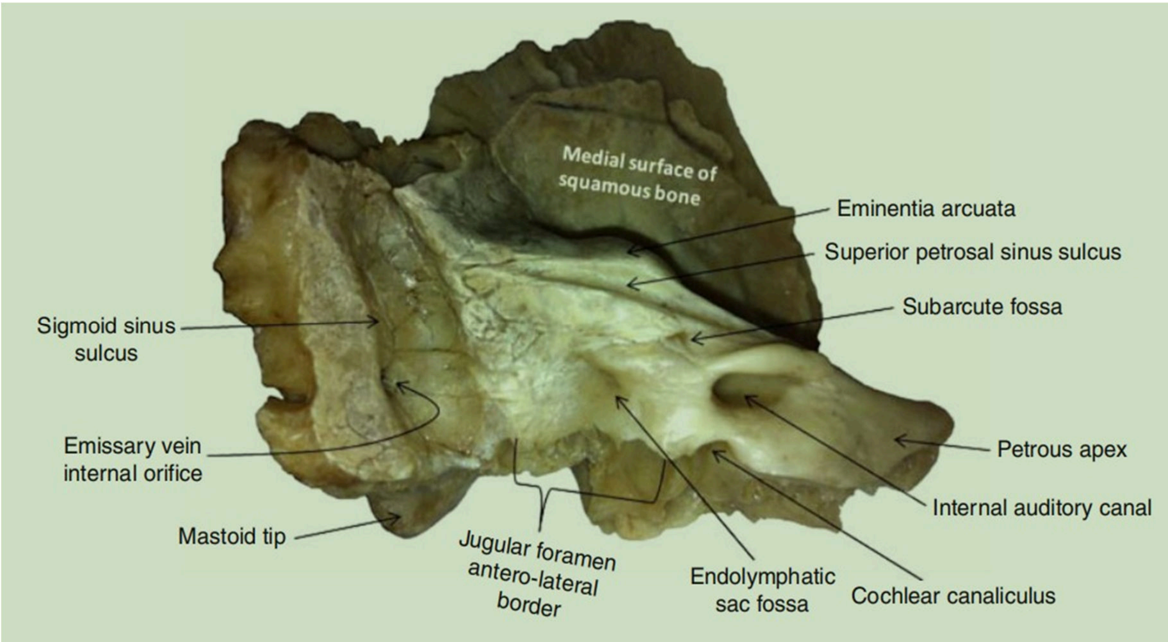


Fig 2 - Posterior surface of temporal bone.[3]

From base of the skull to inferior region, mastoid process extends forming outer surface of temporal bone, behind external auditory meatus.

Mastoid process is immature at birth, at age of two years it starts to develope, and it continues to grow till the age of six. Expansion of mastoid process is a dynamic process that occurs as a result of the pneumatization that occurs within it. The mastoid process, which once contained bone marrow, is invaded by expanding air-filled sacci during pneumatization. Following that, the mastoid develops an air-filled chamber known as mastoid air cells. Septations between mastoid air cells are formed by remaining dense bone that does not pneumatize. [3]

Towards petrosquamous fissure on both sides, the antrum develops in centre of mastoid process. Petrous half of antrum originates from saccus medius, while squamous part of antrum develops from saccus superior[7]. Petrosquamous fissure is formed by fusion plane between petrous and squamous parts. When two sacci fail to fuse completely, the mastoid antrum is divided by a bony division known as Korner's septum.[8]

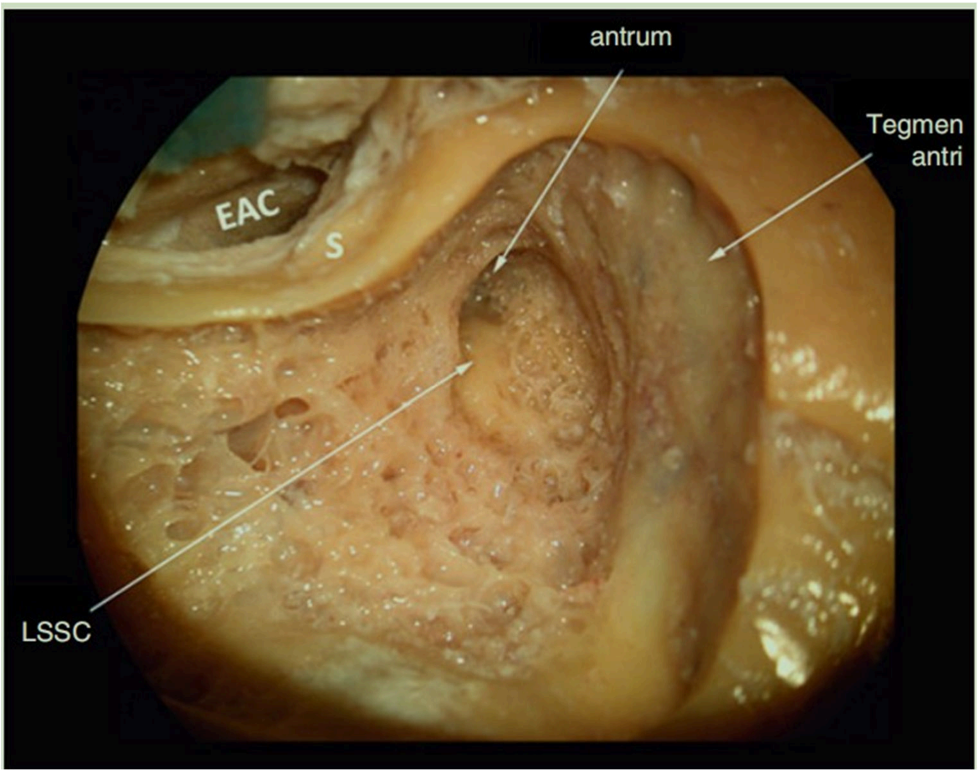


Fig 3 - left temporal bone showing the mastoid antrum.[3]

Only the antrum is present in mastoid process at birth. Mastoid air cells emerge from antrum after birth; epithelial air tracts bud from antrum and expand to neighbouring parts of temporal bone to generate mastoid air cells (Fig 3) . Thus growth is aided by transformation of bone marrow into loose mesenchyme .This is how mastoid pneumatization occurs.[4]

Mastoid air cell system is a complicated network of linked air cells that links to tympanic cavity directly through the mastoid antrum [9]. It promotes gas exchange with its mucosal surface and cushions middle ear pressure between eustachian tube and mastoid air cell system. This is determined in part by the MACS surface area-to-volume ratio and in part by the characteristics of mastoid mucosa vascular congestion.[10]

A history of middle ear disease in childhood, like secretory otitis media and cholesteatoma, is linked to a lower MACS volume. As a result, diminished mastoid pneumatization has been suggested as a sign of middle ear pathology. [10]

This demonstrates that otitis media patients ears have smaller mastoid air cell system and volumes than healthy ears.[11,12]

There is no significant difference in mastoid air cell system measurement values in the same age group, both sexes, indicating that size of mastoid air cell system is unaffected by sex. [11,12,13]

Tracts of Pneumatization

Posterosuperior Cell Tract

Posteriorosuperior tract runs medially from antrum to confluence of posterior and middle fossa dural plates, above superior semicircular canal and internal auditory canal. It pneumatizes temporal bone's medial pyramid.[3]

Posteromedial Cell Tract (Superior Retrolabyrinthine)

To pneumatize medial pyramid, parallel to and inferior to the posterosuperior tract, the posteromedial tract continues medially into the antrum.

Subarcuate Cell Tract (Translabyrinthine)

Subarcuate tract is more medially located. It originates from mastoid antrum and continues anteromedially, passing beneath superior semicircular canal, pneumatizing petrous apex[3].

Elements that influence the degree of pneumatization are not well understood. Several variables, including the state of the mucous membrane, inheritance, the formation of growth centres in the bone, Eustachian tube function, and intercurrent infections, may influence the growth pattern.[4]

Cell Tract of Perilabyrinthine System

Antrum gives birth to the perilabyrinthine cell tract, which pneumatizes labyrinthine area. Supralabyrinthine and infralabyrinthine tracts are separated. It has ability to reach petrous apex [3].

Peritubal Tract

Mastoid antrum gives rise to this tract, which pneumatizes tubal and peritubal areas before moving inferior to labyrinth. [3]

Mastoid Pneumatization Phases

Phase I (0–1 year); At birth, antrum is of adult-sized, with a typical surface area of 1 cm^2.

Phase II (1–6 years): Mastoid pneumatization occurs in this phase in linear manner, adding around 1 cm^2 per year.

Phase III (6 years–puberty): Pneumatization process is quite slow during this period. It lasts until the aerated mastoid process achieves adult size during puberty. Average surface area of mature mastoid air cells is roughly 12 cm^2.

Amount of variance in postnatal mastoid pneumatization is due to a number of factors, including inheritance, environment, infections and eustachian tube function .

Two theories namely:

- **Environmental theory :** This hypothesis states that it is inable for process of pneumatization to develop in infants and children is caused by middle ear illnesses that present early in childhood. [13–17]

- **Genetic theory :** This idea links degree of pneumatization to hereditary variables, claiming that children with inherited low pneumatization are more likely to develop otitis media. [13–17]

Surface Landmarks of the Mastoid Process

Temporal line is a horizontal ridge that runs from top of mastoid process to bottom. It extends past zygomatic process's posterior root and indicates inferior boundaries of temporal muscle's insertion. Inferior level of middle fossa dura is indicated by temporal line. To avoid unintentional dura injury during mastoidectomy , it is usually advisable to drill along, not above temporal line . [17-16]

The Henle's spine, which is located behind and above posterosuperior quadrant of EAC and below beginning of temporal line, is a significant landmark during mastoidectomy since it shows antrum's position[18].

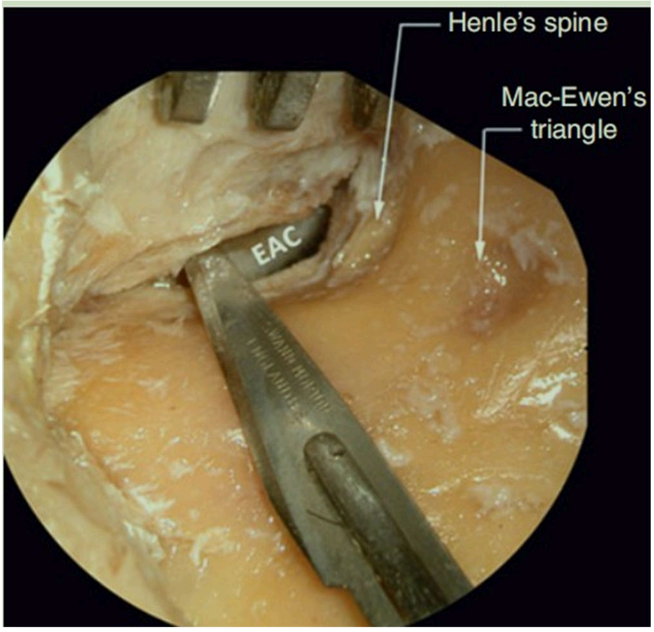


Fig 4 - Left temporal bome showing Spine of Henle[3]

The suprameatal triangle, also known as "Mc-Evan's triangle," is situated between the temporal line's anterior end, Henle's spine, and posterosuperior quadrant of EAC (fig 4) . Mc-Evan's triangle a significant anatomical landmark for surgical access to mastoid antrum, which is around 12–15 mm deeper. [19,20]

Largest mastoid air cell, antrum, measures 10 mm in length and is located posterior to EAC and middle ear, inferior to middle fossa dural plate, and anterior to sigmoid sinus and posterior fossa dural plate . During mastoid surgery, depth of the mastoid antrum is crucial. Area between the cortical bone and antrum in newborns and infants younger than one year is only 2–4 mm. The antrum is 10 mm from cortical bone at 3 years old, and it can be 25 mm from mastoid cortical bone in adults.[21]

Citelli angle is angle formed between dural plates of middle and posterior fossas. This angle is settled by several tiny air cells termed Citelli cells in a well-pneumatized mastoid. During mastoidectomy for chronic suppurative otitis media, these cells must be thoroughly exenterated; otherwise, residual infection of these cells may lead to reappearance of condition.

Mastoid Air Cells

Air cells are restricted to mastoid process and it separates in two sections: Antrum and Mastoid tract.

Because mastoid air cell system is made up of several 'rooms' with exceedingly irregular shapes, measuring full surface area of air cells has never been attempted.[22]

•Antrum is source of peripheral mastoid region. Peripheral tract is made up of tegmental cells above external auditory canal, sinodural angle cells, posteroinferior sinusal cells (around the sigmoid sinus), facial cells (around mastoid portion of facial nerve), and mastoid tip cells, which are divided into medial and lateral groups by digastric ridge. Depending on their distance from sigmoid sinus, mastoid cells are classified as presinusoidal, sinusoidal, or postsinusoidal. [23]

Air cells that surround labyrinth are known as perilabyrinth cells, and they contain supralabyrinthine and infralabyrinthine cells. Posterosuperior, posteromedial, and subarcuate supralabyrinthine cells are subdivided [24–28].

The apical cells are found between internal auditory canal and the carotid canal, medial to internal auditory canal and posteromedial to carotid canal.

Zygomatic , occipital , squamous, and styloid air cells are examples of accessory air cells.

A vascularized cuboidal epithelium covers the mastoid air cell system. The interaction between blood vessels and this epithelium's basement membrane is very similar to that of alveoli, where considerable exchange of gas occurs. In the event of eustachian tube malfunction, mastoid air cell system acts as a reservoir of air and a buffer mechanism, temporarily replacing air in middle ear cavity . Average volume of air in mastoid air cell system is estimated to be between 5 and 8 ml.

There are three types of pneumatization of the mastoid air cell system:

1. Sclerotic mastoid – absence of pneumatization , which is made up of highly thick bone combined with bone marrow and air cells.[4]

2. Diploic mastoid – partial pneumatization , which has marrow instead of air cells.

3. Pneumatic mastoid – complete pneumatization , which makes up the vast bulk of mastoids [4]

Position of sigmoid sinus within mastoid bone is quite variable.

Surgical approaches to tympanic cavity, mastoid antrum, and membranous labyrinth might be complicated by differences in its shape and position of above mentioned structures .

Distance between posterior ear canal wall and sigmoid sinus is directly proportional to degree of complete mastoid pneumatization. Sinodural angle (SDA) - i.e., petro-sigmoid angle - is similarly narrower when the sigmoid sinus is positioned too anteriorly, which helps us determine sigmoid sinus's anterior location. [3]

In pneumatized mastoids, Shatz and Sade discovered a link between degree of pneumatization and distance of the sigmoid sinus from posterior border of external ear canal.[29]

For chronic otitis media with or without cholesteatoma, mastoidectomy is generally used in conjunction with tympanoplasty. In the case of acute mastoiditis with subperiosteal abscess, a cortical mastoidectomy (an intact canal wall approach) is usually performed. The cortical bone covering the antrum is removed with a surgical drill down to the antrum, which is the biggest air cell connected to the posterior portion of the epitympanum through the aditus ad antrum. A full or canal wall up mastoidectomy occurs when all of the lateral mastoid air cells covering the sigmoid sinus, tegmen, and posterior canal wall are removed. It is usually done for chronic otitis media without cholesteatoma. [9]

X-RAY MASTOID

Use of conventional radiography is restricted to assessing mastoid pneumatization and position of dural plate and sinus plate and sino-dural angle.

Today, only three projections are of practical interest:

Lateral or Schuller, vertical, and horizontal view.

Frontal, also known as transorbital view,

Oblique, also known as Stenvers.

X-ray mastoid Schullers view is one of the basic and most easily available and cost effective method of radiological evaluation of mastoid air cell system. It not only provides details of the pneumatization pattern of mastoid air cell system but also that of the important surgical landmarks , which are of extreme significance intraoperatively such as the dural plate , sigmoid sinus , sino-dural angle.

Early childhood middle ear infection prevents normal development of mastoid pneumatization, hence mastoid pneumatization may be a predictive indicator in otitis media, according to a well-documented link between pneumatization and infection. [30]

Mastoid cavity is not just an air reservoir, but also an active region for exchange of gas, with air cell system capable of allowing gas exchange via its submucosal capillary network, which plays a crucial role in gas exchange between mastoid air cells and submucosal capillaries.[8]

The mastoid air cells are shielded with highly vascularized cuboidal type of epithelium , and contact between blood vessels and mucosa's basement membrane is closer than in other parts of the middle-ear cleft, which are more typical of respiratory epithelium that performs gas exchange. Because gas exchange happens through diffusion, the rate is influenced by surface area.

Because overall surface area of mastoid air cell system is same as the total area of mucosa with gas exchange capability, our findings suggest that well pneumatized mastoid air cells provide an unusually large mucosal area in the temporal bone. Therefore, this would be an important factor in influencing the diffusion rate of gas in the middle ear.[22]

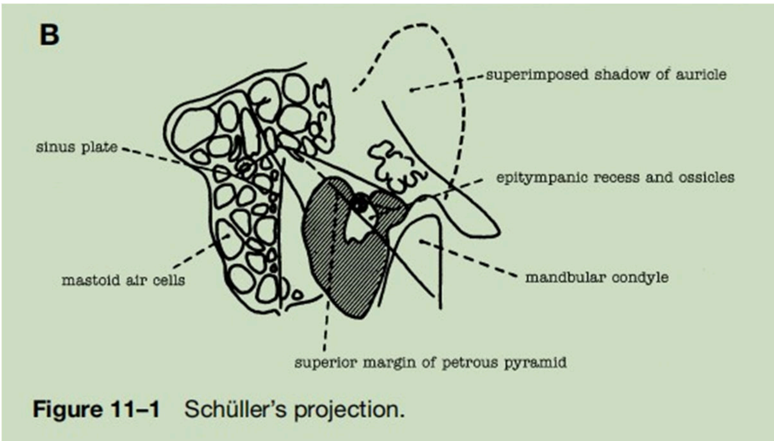


Fig 5 - Schematic diagram of structures seen in x ray mastoid schullers view[3]

Schuller projection is a lateral image of mastoid acquired with sagittal plane of skull parallel to tabletop and a 30-degree cephalocaudad angulation of x-ray beam. External auditory canal of the side to be examined is placed 1 cm above centre of the film or tabletop for proper centering. Lateral sinus's anterior plate superimposes an almost vertical line on the air cells.

This line meets the tegmen plate, which slopes gradually forward and downward, near its upper extremity X-ray beam's angulation has relocated superior petrous ridge's more medial portion, from arcuate eminence to apex, casting a line that runs forward and downward, passing the epitympanic area and, more anteriorly, of mandibular condyle's neck. Above this line, top section of attic, including malleus' head, is generally visible.

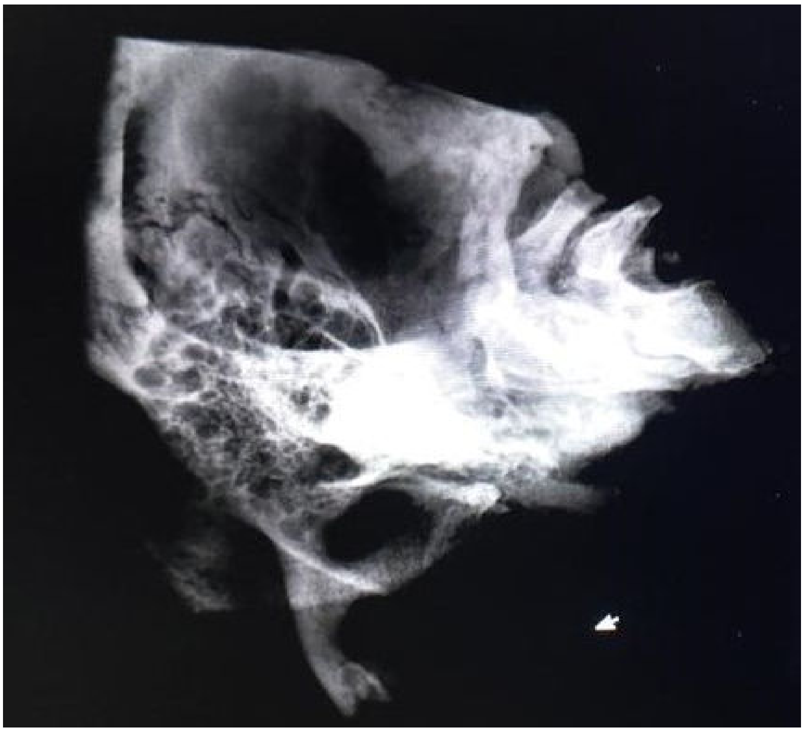


Fig 6 showing left sided x ray mastoid schullers view

Clinical Importance of study - In my study , we have co-related variations in anatomy of mastoid air cell system on pre operative digital radiograph , dissection method and post dissection digital radiograph .

Pre dissection radiograph gives us knowledge of the pattern of pneumatization of mastoid air cell system , the chances of having a cavity in mastoid is less in well pneumatized mastoid as compared to the diploic or sclerotic mastoid . The presence of diploic or sclerotic pattern of pneumatization points towards the active or previous infection in childhood of the mastoid air cell system impairing growth of air cell system .

1 ml gas loss from a 2-cm^3 middle ear cleft (50 percent of what exists there) will result in a large pressure drop, but the same 1 ml gas loss from a 20-cm^3 middle ear cleft (only 5% of what exists there) will result in a minimal pressure drop. As a result, a severe TM atelectasis is predicted to occur in the small mastoid process (the 2-cm^3 ME cleft), but no atelectasis is likely to form in the big mastoid process (the 20-cm^3 ME cleft). As a result, the degree of ME negative pressure is determined by the amount of gas gained and lost through the ET and mucosa, as well as the extent of mastoid pneumatization.[31]

Thus , having a post dissection small mastoid cavity creates a negative impact for the graft to take up in case of dysfunction eustachian tube . Hence it is important to have a adequate size mastoid cavity and functional eustachian tube post operatively , like in childern the central patholgies like adenoidits shoud be first treated and in case of adults patients central pathologies like deviated nasal septum , nasal polyps (antrachoanal polyp) should be first corrected .

The pre dissection radiograph gives us information of postion of dural plate , if the dural plate is low lying which is picked up in a pre dissection radiograph the chances of causing intra operative damage to low lying dural is considerabely reduced , as the surgeon is aware of this anatomical variation and thus takes precautionary measure to prevent injury to it.

The pre dissection radiograph also gives us information about the position of sigmoid plate , thus this anatomical variation is picked up pre operatively thus reducing the risk of intraoperatively damage to sigmoid sinus , which if damaged becomes challening for the surgeon to achieve haemostasis and provide a well saucerized and smooth mastoid cavity post operatively .

The post dissection digital x-ray mimic post operative status of mastoid cavity , which has to be of adequate size to prevent cavity problems . Large cavity is always difficult to epitheliaze and requires frequent cleaning to avoid collection of debris and leading to secondary infection .

MATERIALS AND METHODS

Study Design:- Observational study

Study Period:- 1year [January 2020- December 2020]

Source of data:- Cadaveric temporal bones obtained from Department of Anatomy of Jawaharlal Nehru Medical College

Sample Size:- 30 formalin fixed temporal bones

Ethical clearance:- Ethical clearance was obtained from the Institutions Ethical Clearance Committee

Inclusion criteria:- Temporal bones from cadavers subjected for dissections

Exclusion criteria:- temporal bones with any evidence of previous surgeries .

Temporal bones with history of any evidence of trauma

Methodology:

Wet mounted specimen of cadaveric temporal bone was subjected to x-ray mastoid schullers view. Surface area , distance between dural plate and mastoid tip , sigmoid sinus and posterior wall of EAC was measure on X-ray

After numbering the specimen , a cortical mastoidectomy was performed on wet mounted specimen of cadaveric temporal bone. Typmanic membrane status , ossicular status , volume of mastoid cavity using aspiration technique with saline after blocking the additus with bone wax , and distance between dural plate and mastoid tip , sigmoid sinus and posterior wall of EAC using vernier calliper .

After completion of cortical mastoidectomy , the same cadaveric temporal bone was subjected to post drilling x-ray mastoid schullers view to measure the surface area , distance between dural plate and mastoid tip , sigmoid sinus and posterior wall of EAC. Temporal bones were numbered and categorically and stored in boxes with formalin

All measurements were noted and analyzed based on their distribution of mean , median and standard deviation were calculated . Statistical analysis was done by Chi-Square test , Paired t test , Independent t test .

Photo A &B - X-ray mastoid of the temporal bone

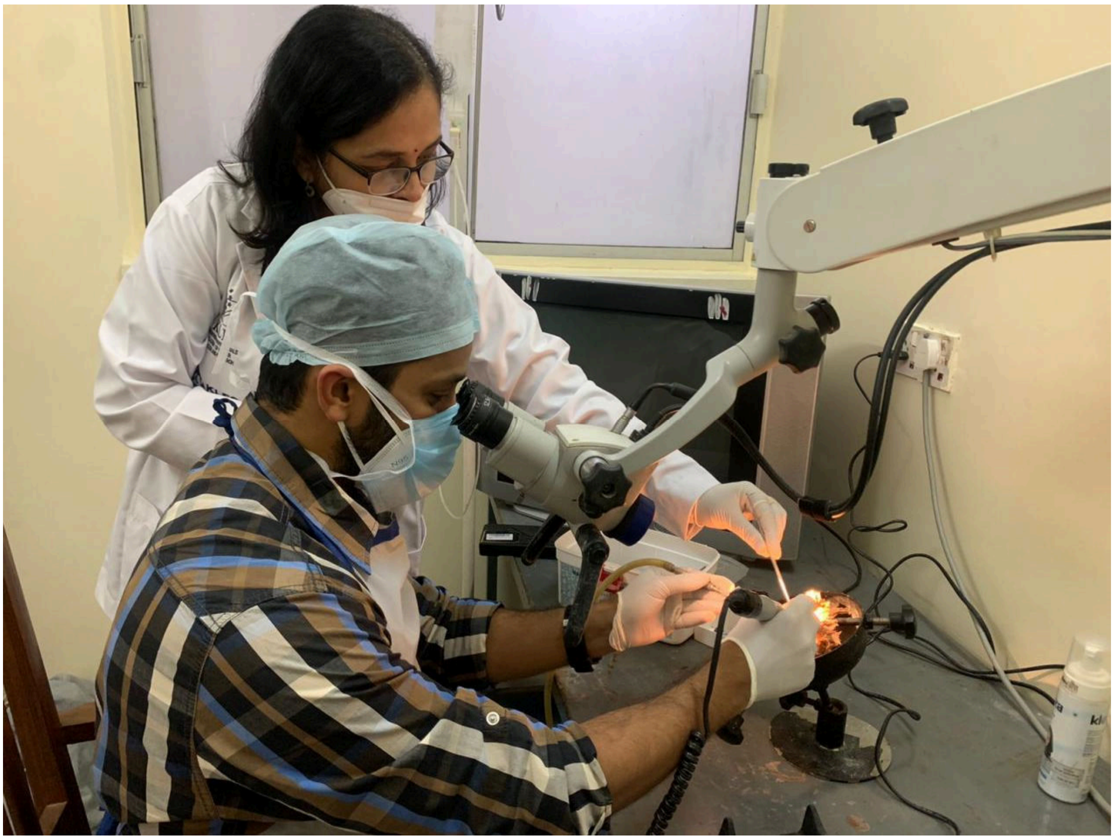


Photo C - Dissection of temporal bone in dissection lab

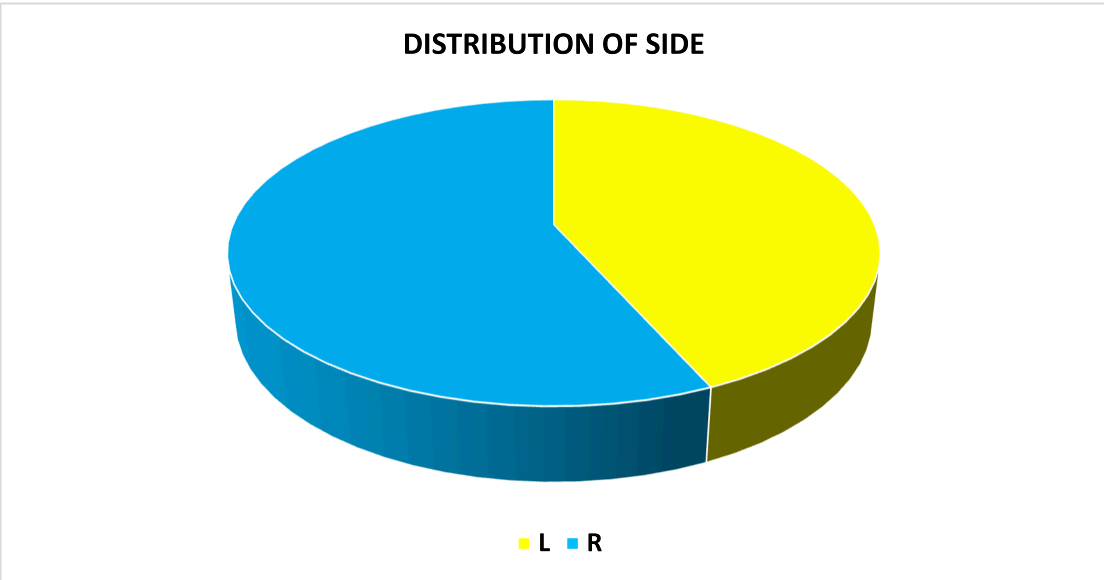
RESULTS

Distribution of side

SIDE	NUMBER	%
L	13	43.33
R	17	56.67
TOTAL	30	100.00

Table 1.1 - Distribution of side

In my study of the 30 temporal bones dissected, 13 (43.33 %) were of the left side and 17 (56.67 %) were of right side . there was no significant difference between the side of temporal bone dissected .



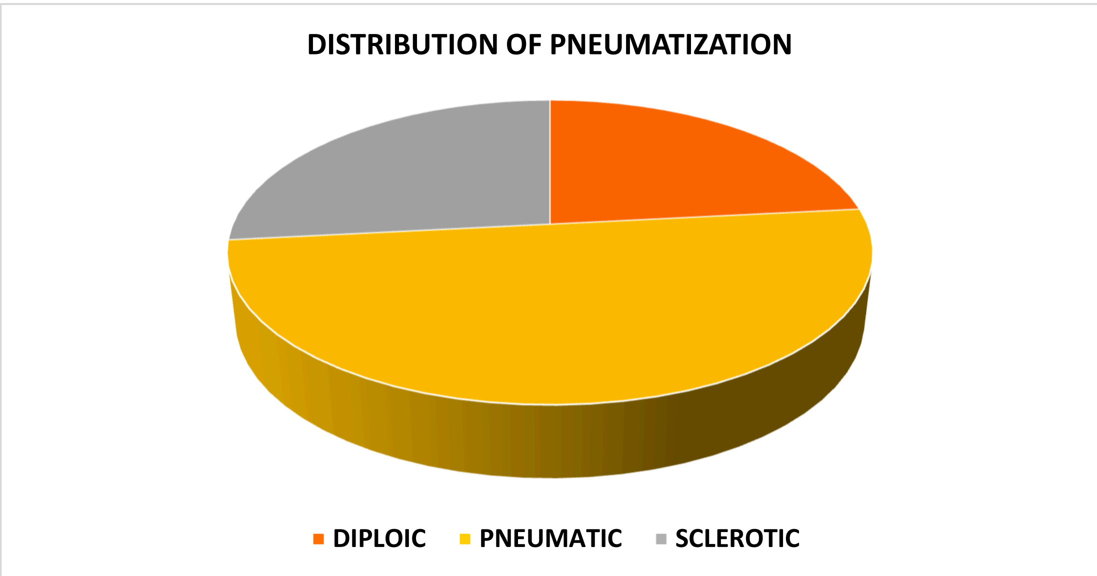
Graph 1.1 - Distribution of side

Type of pneumatization

TYPE OF PNEUMATIZATION	NUMBER	%
DIPLOIC	7	23.33
PNEUMATIC	15	50.00
SCLEROTIC	8	26.67
TOTAL	30	100.00

Table 1.2 - Type of pneumatization

In my study of the 30 temporal bones dissected, 15 were pneumatic (50 %) , diploic were 7 (23.33 %) , sclerotic 8 (26.67 %) .



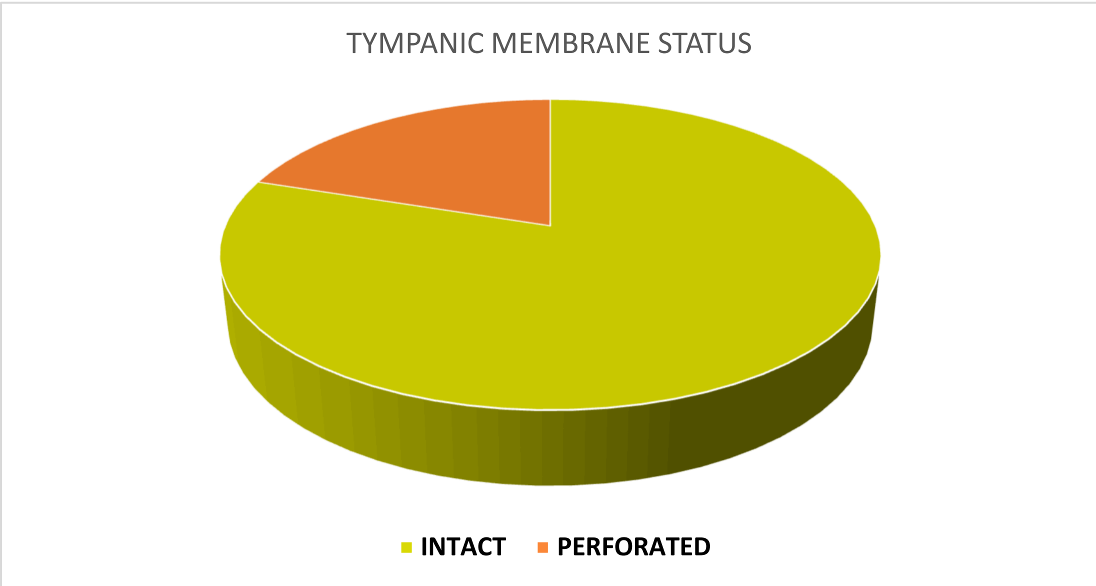
Graph 1.2 - Distrubution of pneumatzation

Tympanic membrane status

TYMPANIC MEMBRANE STATUS	NUMBER	%
INTACT	24	80.00
PERFORATED	6	20.00
TOTAL	30	100.00

Table 1.3 - Status of tympanic membrane

In my study of 30 temporal bone dissection , perforated tympanic membrane were found in 6 (20%) cadavers and intact tympanic membrane were found in 24 (80%) cadavers



Graph 1.3 - Showing the status of tympanic membrane

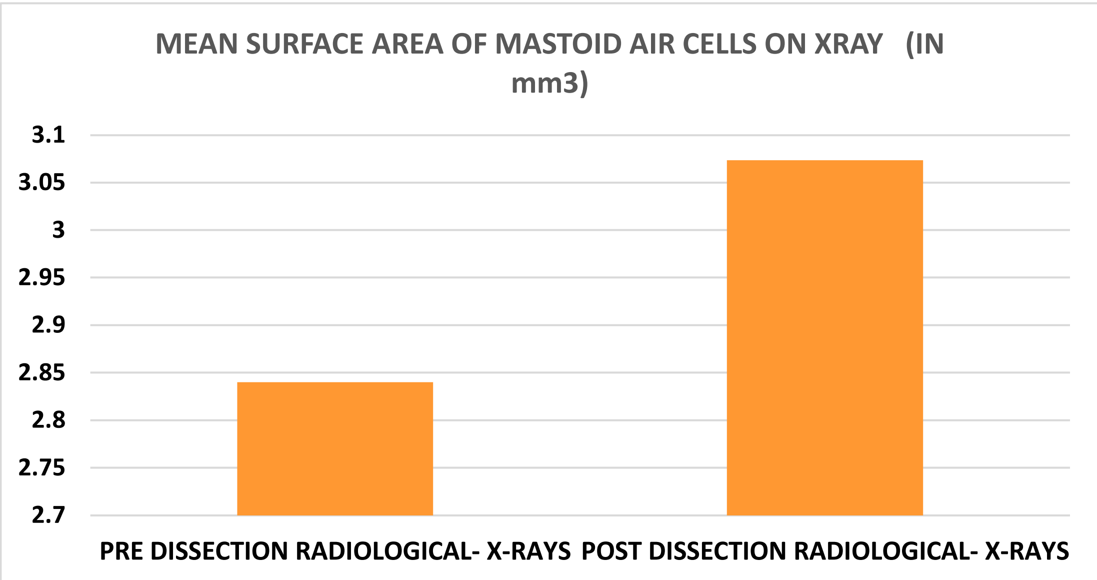
SURFACE AREA OF MASTOID AIR CELLS ON XRAY (IN mm3)						
	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL- X-RAYS	2.84	0.71	1.7	4.2	0.2092	NS
POST DISSECTION RADIOLOGICAL- X-RAYS	3.07	0.71	1.9	4.7		

Table 1.4 - Surface area of mastoid air cell system on pre and post dissection x-ray

In my study of 30 temporal bone dissection, mean of surface area of mastoid air cell in pre dissection x-ray was 2.84 +/- 0.71 , with maximum value was 4.2 mm^3 and the minimum value was 1.7 mm^3 .

And similarly in post dissection x-ray the mean of surface area of mastoid air cell in was 3.07 +/- 0.71 , with the maximum value was 4.7 mm^3 and the minimum value was 1.9 mm^3 .

In the following table the p value was calculated using the unpaired t test which was 0.2092 , thus there is no significant difference between the mean value of mean of mastoid air cell system in pre and post dissection x-ray mastoid .

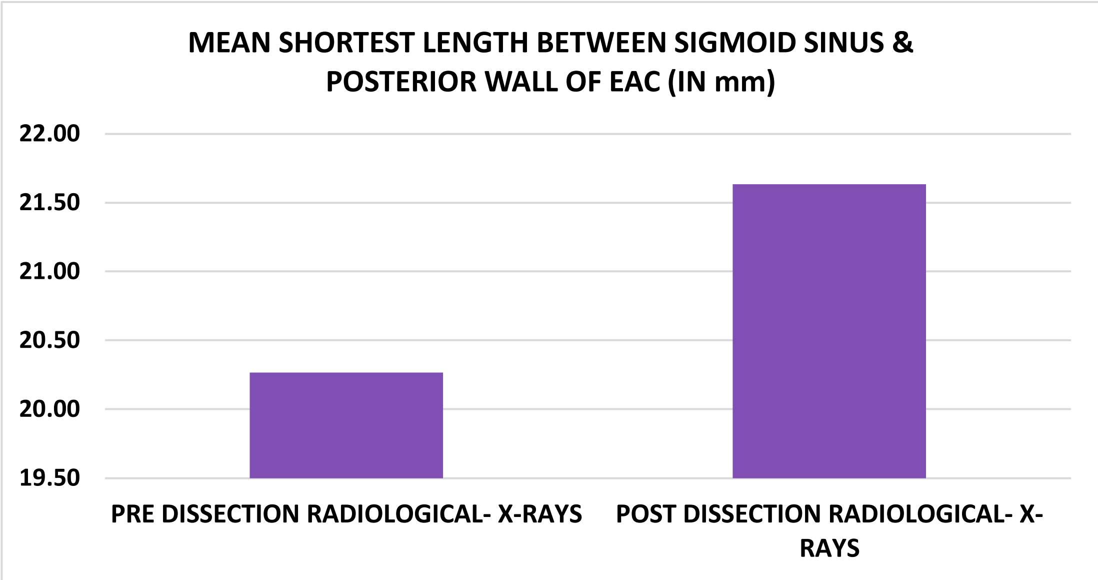


Graph 1.4 -Mean surface area of mastoid air cell on X-ray (IN mm3)

SHORTEST LENGTH BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL- X-RAYS	20.27	3.00	15	27	0.0711	NS
POST DISSECTION RADIOLOGICAL- X-RAYS	21.63	2.75	16	29		

Table 1.5 - Shortest distance between sigmoid sinus and posterior wall of EAC (IN mm)

In my study of 30 temporal bone dissection, the mean of shortest length between sigmoid sinus and posterior wall of EAC in pre dissection x-ray was 20.27 +/- 3.0 , with the maximum value was 27 mm and the minimum value was 15 mm .
And similarly in post dissection x-ray the mean of shortest length between sigmoid sinus and posterior wall of EAC was 21.63 +/- 2.75 , with the maximum value was 29 mm and the minimum value was 16 mm.
In the following table the p value was calculated using the unpaired t test which was 0.0711 , thus there was no significant difference between mean value of shortest length between sigmoid sinus and posterior wall of EAC in pre and post dissection x-ray mastoid .



Graph 1.5 - Mean value of shortest length between sigmoid sinus and posterior wall of EAC .

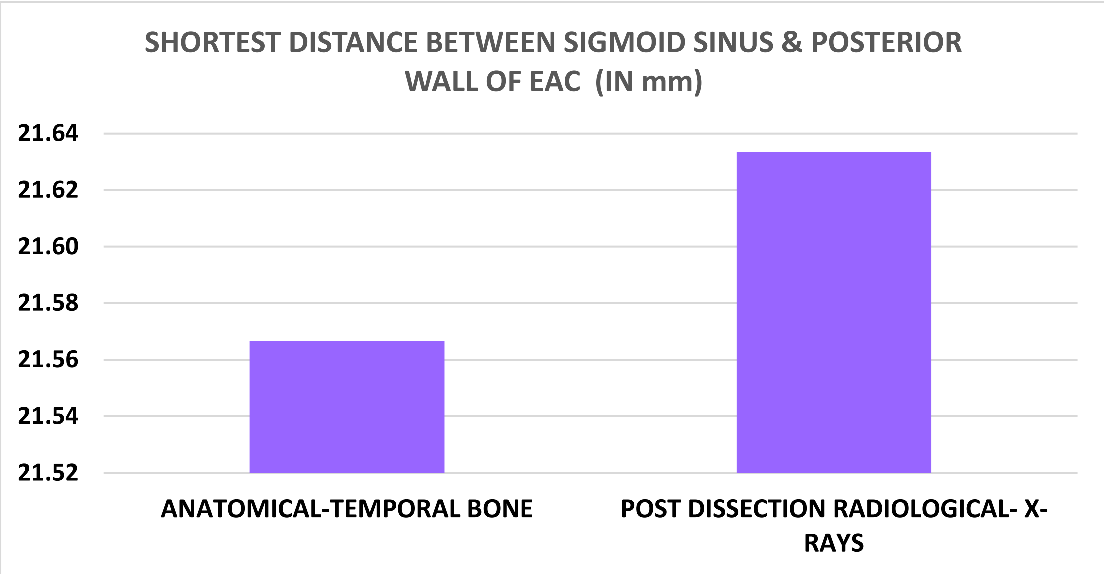
SHORTEST LENGTH BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
ANATOMICAL-TEMPORAL BONE	21.57	3.04	16	27	0.9293	NS
POST DISSECTION RADIOLOGICAL-X-RAYS	21.63	2.75	16	29		

Table 1.6 - Shortest length between sigmoid sinus and posterior wall of EAC

In my study of 30 temporal bone dissection, the mean shortest length between sigmoid sinus and posterior wall of EAC in anatomical dissection method was 21.57 +/- 3.04 , with the maximum value was 27 mm and the minimum value was 16 mm .

And similarly in post dissection x-ray the mean of shortest length between sigmoid sinus and posterior wall of EAC was 21.63 +/- 2.75 , with the maximum value was 29 mm and the minimum value was 16 mm.

In the following table the p value was calculated using the unpaired t-test which was 0.9293 , thus there was no significant difference between shortest length between sigmoid sinus and posterior wall of EAC in anatomical dissection method and post dissection x-ray measurements .



Graph 1.6 - Shortest length between sigmoid sinus and posterior wall of EAC

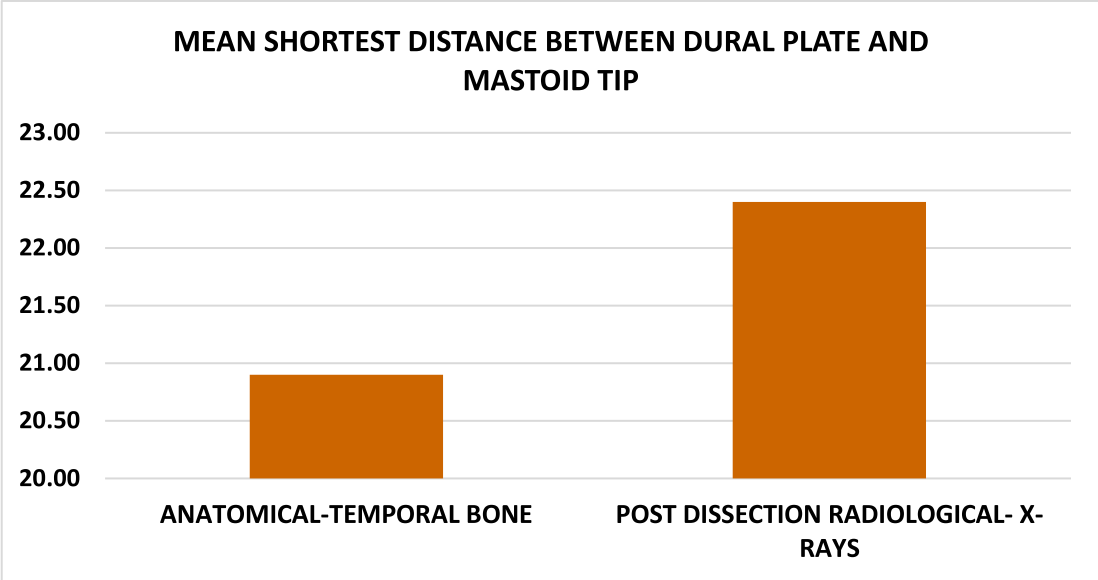
SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
ANATOMICAL-TEMPORAL BONE	20.90	3.33	13	28	0.0727	NS
POST DISSECTION RADIOLOGICAL- X-RAYS	22.40	3.02	16	28		

Table 1.7 - Shortest distance between dural plate an mastoid tip

In my study of 30 temporal bone dissection, the mean shortest distance between dural plate an mastoid tip in anatomical dissection method was 20.90 +/- 3.33 , with the maximum value was 28 mm and the minimum value was 13 mm .

And similarly in post dissection x-ray the mean of Shortest distance between dural plate an mastoid tip was 22.40 +/- 3.02 , with the maximum value was 28 mm and the minimum value was 16 mm .

In the following table the p value was calculated using the unpaired t test which was 0.0727 , thus there was no significant difference between the shortest distance between dural plate an mastoid tip in anatomical dissection method and post dissection x-ray measurements .



Graph 1.7 - Mean of shortest distance between dural plate and mastoid tip

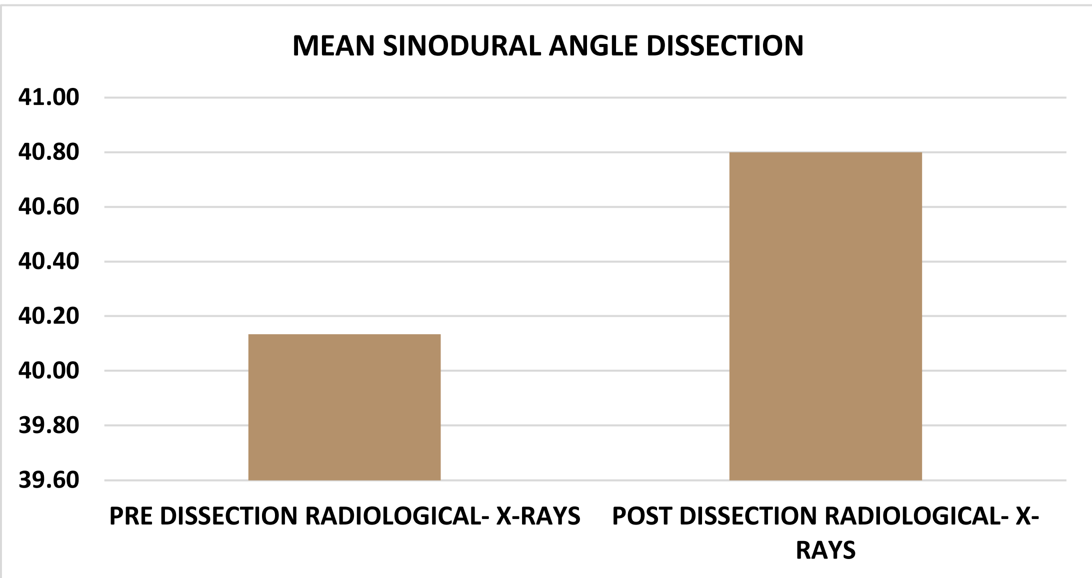
SINODURAL ANGLE						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL-X-RAYS	40.13	8.63	27	56	0.7565	NS
POST DISSECTION RADIOLOGICAL-X-RAYS	40.80	7.93	30	56		

Table - 1.8 Sinodural angle

In my study of 30 temporal bone dissection, the mean of sinodural angle in pre dissection x-ray was 40.13 +/- 8.63 , with the maximum value was 56 and the minimum value was 27.

And similarly in post dissection x-ray the mean sino-dural angle was 40.80 +/- 7.93 , with the maximum value was 56 and the minimum value was 30.

In the following table the p value was calculated using the unpaired t test which was 0.7565 , thus there was no significant difference between sino-dural angle in pre and post dissection x-ray mastoid .



Graph - 1.8 Sinodural angle

In my study , of the 30 temporal bone dissection done , the surfare area and volume of mastoid air cell system was as follows

SURFACE AREA OF MASTOID AIR CELLS (IN mm3)				
TEMPORAL BONE NUMBER	SIDE	pre op x-ray	anatomical volume	post op x-ray
1	R	3.2	3.9	3.6
2	R	2.6	3.1	2.7
3	R	4.2	5.1	4.7
4	L	3.3	4	3.7
5	L	1.7	1.9	1.9
6	R	2.7	3.1	3.0
7	R	2.4	2.4	2.7
8	L	3.1	2	3.3
9	R	4.2	4.2	4.6
10	R	1.7	2	1.9
11	L	1.9	2	1.9
12	L	3.4	3.8	3.6
13	R	2.8	3	2.8
14	R	2.6	2.9	2.7
15	L	3.4	3.4	3.8
16	R	3.8	4.1	3.8
17	L	2.7	2.9	2.9
18	R	2.1	2.1	2.4
19	R	3.2	3.5	3.3
20	R	2.4	2.1	2.4

21	L	1.9	1.9	2.5
22	L	2.3	2.4	2.6
23	R	3.5	3.8	3.5
24	L	2.1	2.4	2.5
25	L	3.5	3.5	3.5
26	R	2.4	2.7	2.9
27	R	3.6	3.4	3.6
28	L	2.1	2.4	2.6
29	L	3.5	3.9	3.5
30	R	2.9	3.3	3.3

SURFACE AREA OF MASTOID AIR CELLS ON XRAY (IN mm3)						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL- X-RAYS	2.84	0.71	1.7	4.2	< 0.0001	NS
ANATOMICAL-TEMPORAL BONE	3.04	0.84	1.9	5.1		
POST DISSECTION RADIOLOGICAL- X-RAYS	3.07	0.71	1.9	4.7		

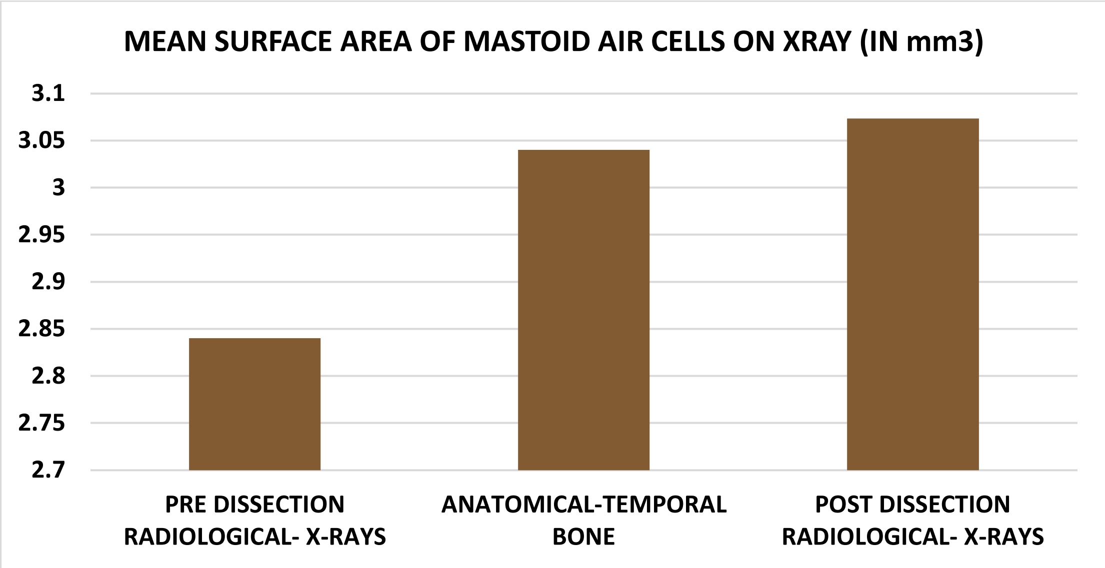
Table 1.9- Surface area of mastoid air cells

In my study of 30 temporal bone dissection, the mean of surface area of mastoid air cell in pre dissection x-ray was 2.84 +/- 0.71 , with the maximum value was 4.2 mm^3 and the minimum value was 1.7 mm^3.

Similarly , mean of surface area of mastoid air cell in anatomical dissection method was3.04 +/- 0.71 , with the maximum value was 5.1 cc and the minimum value was1.9 cc

And similarly in post dissection x-ray mean of surface area of mastoid air cell in was 3.07 +/- 0.71 , with the maximum value was 4.7 mm^3 and the minimum value was 1.9 mm^3 .

In the following table the p value was calculated using one way analysis of variance which was <0.0001 , thus there was no significant difference between the mean value of mean of mastoid air cell system in pre and post dissection x-ray mastoid and anatomical dissection method .



Graph -1.9 - Mean of surface area of mastoid air cell system

In my study of 30 temporal bone dissection , the measurements of the shortest length between sigmoid sinus and posterior wall of EAC is mentions as below

SHORTEST LENGTH BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)				
TEMPORAL BONE NUMBER	SIDE	pre op x-ray	anatomical dissection	post op x-ray
1	R	17	20	18
2	R	18	20	18
3	R	22	24	23
4	L	19	21	20
5	L	15	16	16
6	R	19	21	21
7	R	19	20	20
8	L	21	20	22
9	R	20	21	20
10	R	18	18	21
11	L	16	17	18
12	L	26	27	26
13	R	22	24	22
14	R	19	21	21
15	L	27	27	29
16	R	24	25	23
17	L	19	22	20
18	R	17	17	21
19	R	21	24	21
20	R	20	21	24
21	L	16	17	19
22	L	18	19	21
23	R	24	25	24
24	L	19	21	21
25	L	23	24	24
26	R	22	23	23
27	R	25	24	26
28	L	22	26	25
29	L	19	19	21
30	R	21	23	21

SHORTEST LENGTH BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)						
	MEAN	**S.D.**	**MIN**	**MAX**	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL- X-RAYS	20.27	3.00	15	27	0.1319	NS
ANATOMICAL-TEMPORAL BONE	21.57	3.04	16	27		
POST DISSECTION RADIOLOGICAL- X-RAYS	21.63	2.75	16	29		

Table1.10- Shortest length between sigmoid sinus and posterior wall of EAC (IN mm)

In my study of 30 temporal bone dissection, the mean Shortest length between sigmoid sinus and posterior wall of EAC in pre dissection x-ray was 20.27 +/- 3.0 , with the maximum value was 27 mm and the minimum value was 15 mm.

Similarly , the mean shortest length between sigmoid sinus and posterior wall of EAC anatomical dissection method was 21.57 +/- 3.04 , with the maximum value was 27 mm and the minimum value was 16 mm

And similarly in post dissection x-ray the mean of Shortest length between sigmoid sinus and posterior wall of EAC was 21.63 +/- 2.75 , with the maximum value was 29 mm and the minimum value was 16 mm.

In the following table the p value was calculated using one way analysis of variance which was 0.1319 , thus there was no significant difference between Shortest length between sigmoid sinus and posterior wall of EAC in anatomical dissection method and pre and post dissection x-ray measurements .

In my study of 30 temporal bone dissection , the measurements of the Shortest distance between dural plate and mastoid tip is mentions as below

SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP (IN mm)				
TEMPORAL BONE NUMBER	SIDE	pre op x-ray	anatomical dissection	post op x-ray
1	R	20	20	23
2	R	27	20	27
3	R	23	23	23
4	L	16	19	21
5	L	14	13	16
6	R	17	19	23
7	R	20	22	25
8	L	20	21	26
9	R	22	22	22
10	R	17	18	17
11	L	19	18	20
12	L	21	21	24
13	R	24	24	24
14	R	22	24	22
15	L	25	25	25
16	R	23	23	25
17	L	22	24	22
18	R	20	21	24
19	R	24	24	24
20	R	18	16	21
21	L	15	17	16
22	L	19	18	21
23	R	22	22	23
24	L	16	15	18
25	L	25	25	26
26	R	20	20	20
27	R	19	19	21
28	L	24	24	24
29	L	26	28	28
30	R	20	22	21

SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP						
	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
PRE DISSECTION RADIOLOGICAL- X-RAYS	20.67	3.34	14	27	0.0852	NS
ANATOMICAL-TEMPORAL BONE	20.90	3.33	13	28		
POST DISSECTION RADIOLOGICAL- X-RAYS	22.40	3.02	16	28		

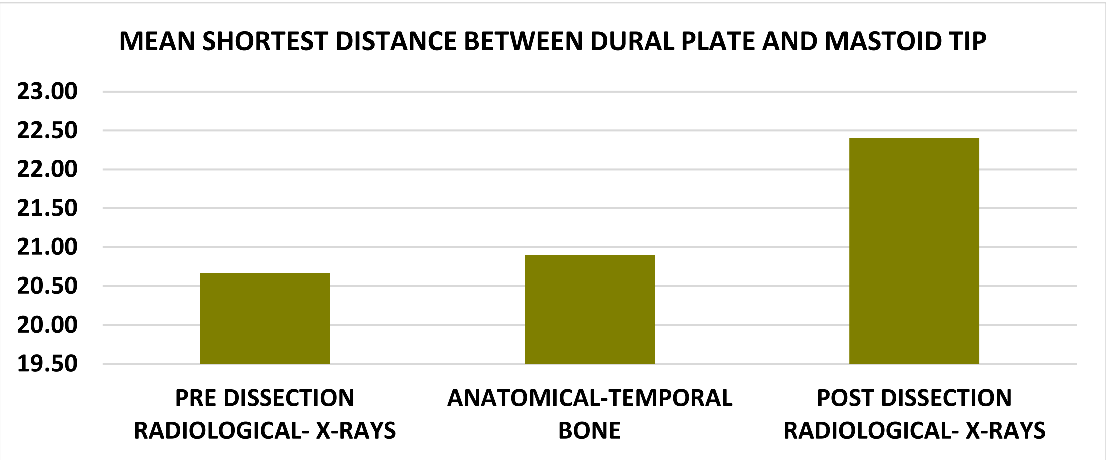
Table 1.11- Shortest distance between dural plate and mastoid tip in pre dissection , anatomical dissection method and post dissection x-ray.

In my study of 30 temporal bone dissection, in pre dissection x-ray the mean of shortest distance between dural plate and mastoid tip was 20.67 +/- 3.34 , with the maximum value was 27 mm and the minimum value was 14 mm.

Similarly, the mean shortest distance between dural plate and mastoid tip in anatomical dissection method was 20.90+/- 3.33 , with the maximum value was 28 mm and the minimum value was 13 mm.

And similarly in post dissection x-ray the mean of Shortest distance between dural plate and mastoid tip was 22.40 +/- 3.02 , with the maximum value was 28 mm and the minimum value was 16 mm.

In the following table the p value was calculated using one way analysis of variance which was 0.0852 , thus there was no significant difference between the dural plate and mastoid tip in anatomical dissection method and pre and post dissection x-ray measurements .



Graph 1.10 - Mean of shortest distance between dural plate and mastoid tip

TYPE OF PNEUMATIZATION	M - I- S+	M - I+S+	M + I- S+	M + I+ S+	TOTAL
DIPLOIC	0	0	0	7	7
PNEUMATIC	0	0	0	15	15
SCLEROTIC	1	3	1	3	8
TOTAL	1	3	1	25	30

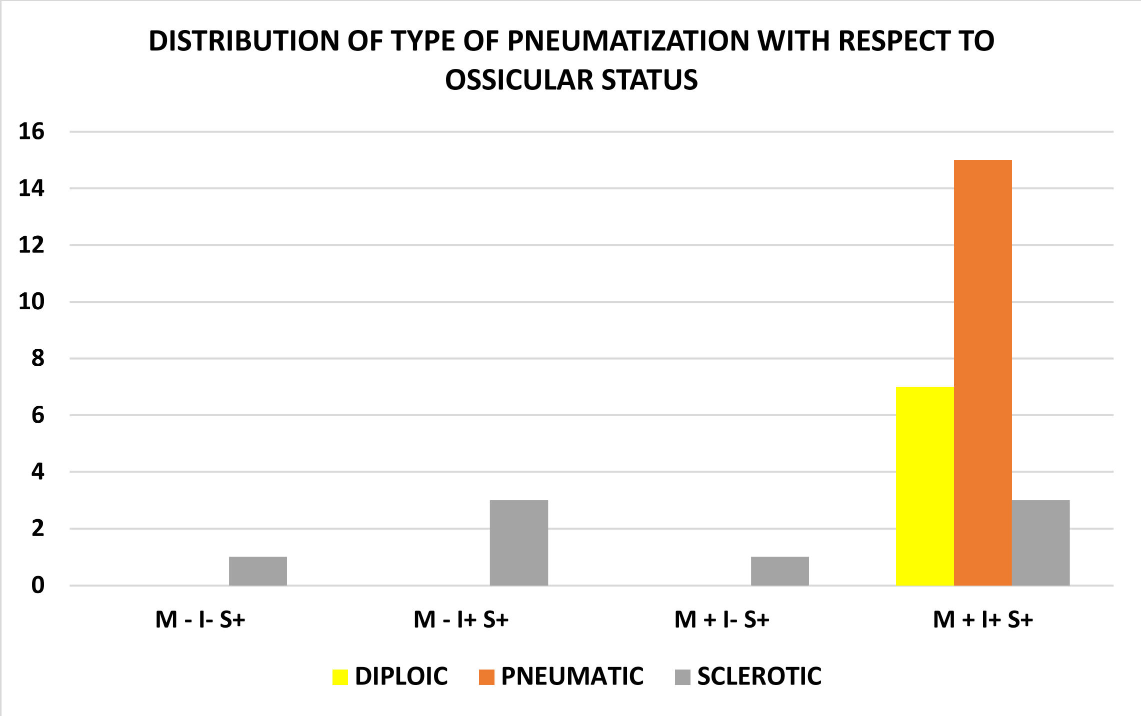
Table 1.12 - Type of pneumatization and Ossicular status

In my study of 30 temporal bones , diploic pattern of pneumatization was found in 7 temporal bones , pneumatic type of pneumatization was found in 15 temporal bones and sclerotic type of pneumatization was found in 8 temporal bones .

Of the 7 diploic temporal bones , all of the 7 bones all 3 ossicles (malleus , incus, stapes) were present .

Of the 15 pneumatic temporal bones , all the 15 bones all 3 ossicles (malleus , incus, stapes) were present .

Of the 8 sclerotic temporal bones , 3 temporal bones all 3 ossicles (malleus , incus, stapes) were present ,in other 3 temporal bones malleus was absent , in 1 temporal bone incus was absent , and the other 1 temporal bone malleus and incus both were absent.



Graph 1.11 - Distribution of type of pneumatization with respect to ossicular status

DISCUSSION

Knowledge of anatomy and its variations is extremely important for surgeons to prevent untoward complications . It is very important to know the minute detailed anatomy and different anatomical variations of temporal bone as it is a complex structure and it has varied anatomical variations . Main aim of my study was to find out surface area of mastoid air cell system , length between sigmoid sinus and posterior wall of EAC, and distance between dural plate and mastoid tip .

Side distribution and pneumatization pattern

In our study , out of 30 temporal bones 13 bones are of left side and 17 bones are of right side , out of which 15 showed pneumatic type of pneumatization pattern , 7 were diploic type of pneumatization pattern and 8 were sclerotic type of pneumatization .

Mean surface area of mastoid air cell system

In our study mean surface area of mastoid air cell system , in pre dissection digital x-ray was 20.27 and post dissection digital x-ray was 21.63 and anatomical dissection method was 3.04, which was stastitically not significant (p value 0.0711) . Nikolaj et al. Found mean surface area of mastoid air cell system was different in axial and coronal plane on CT scan which was statistically significant . However there is lack of study to measure pre and post dissection surface area of mastoid air cell system on digital x-ray.[11]

Chatterjee et al. Found mean surface area of mastoidaair cell system on x-ray mastoid using planimetric method and was not found to be stastically significant when compared with different age group.[32]

Cinnamon et al. In 2009 studied positive association between volume and surface area in mastoid air cell system, but this does not ensure a direct proportion between the two in pathological situations because only normal air cell systems were studied and results were not found to be statistically significant in this study.[33]

Mastoid air cell system is a complicated structure of linked air cells that serves two purposes. It promotes gas exchange with its mucosal surface and cushions the middle ear pressure between Eustachian tube apertures.

Distance between sigmoid plate and posterior wall of EAC

In our study , mean length between sigmoid sinus plate and posterior wall of EAC in pre dissection x-ray was 20.27 , in anatomical dissection method was 21.57 and post dissection x-ray was 21.63 , which was statistically not significant (p value 0.1319) .

Aslan et al. Found the mean length between sigmoid sinus plate and posterior wall of EAC was statically significant when compared with pneumatic and sclerotic bone on CT scan temporal bone.[34]

Turgot et al. Did found that mean length between sigmoid sinus plate and posterior wall of EAC with degree of pneumatization was statically insignificant.[20]

Anat shatz et al. Did found that mean length between sigmoid sinus plate and posterior wall of EAC with degree of pneumatization was statically significant.[29]

Placement of sigmoid sinus within mastoid cavity is very varied and crucial for planning and performing surgery within cavity. [35]

Distance between dural plate and mastoid tip

In our study , the mean distance between dural plate and mastoid tip in pre dissection x-ray was 20.67 , in anatomical dissection method was 20.90 and post dissection x-ray was 22.40 , which was statistically not significant (p value 0.0852)

Turgut et al. Found the distance between dural plate and mastoid tip and degree of pneumatization which was statistically not significant. The middle fossa dura has significant anatomical variation whose positions should be considered while performing mastoidectomy.[20]

Ossicular status

Of the 7 diploic temporal bones , all of the 7 bones all 3 ossicles (malleus , incus, stapes) were present .

Of the 15 pneumatic temporal bones , all the 15 bones all 3 ossicles (malleus , incus, stapes) were present .

Of the 8 sclerotic temporal bones , 3 temporal bones all 3 ossicles (malleus , incus, stapes) were present ,in other 3 temporal bones malleus was absent , in 1 temporal bone incus was absent , and the other 1 temporal bone malleus and incus both were absent.[36]

This is, however, a preliminary research , more research is needed to determine the association between surface area , volume of mastoid air cell system, length between sigmoid sinus plate and posterior wall of EAC and dural plate and mastoid tip and real operative findings .

CONCLUSION

In this study, 30 cadaveric temporal bones were studied to assess any existing correlation between the mastoid air cell systems and its relative vital structures associated with it. A cadaveric temporal bone dissection study is a must and comp good simulation for intraoperative scenario, and also serves as an important learning tool for the surgeon. In the light of possible anatomical variations of the MACS and middle ear this study represents the need for anticipated corrections without causing damage to the vital structures in mastoid cavity and middle ear . important surgical landmarks such as the sigmoid sinus , tegmen plate are of significant importance in mastoid surgeries and a careful assesment of this region should be carried out during mastoidectomy .Also to assess the pre operative size of mastoid cavity and the time needed to carry out cortical mastoidectomy is rightly estimated by pre operative X-ray.

X-ray is an easily available, cost effective & widely used imaging modality in routine otological practice. X-ray mastoid schullers view is done as a routine pre operative evaluation to assess the primary pathology of the MACS, in this study we see that there is significant correlation between an X-ray MACS and that seen during dissection (Cortical mastoidectomy) of the respective bone. Hence suggesting the importance of an X-ray of the mastoid.

Till date no such study has been done on cadaveric temporal bones for the assessment of MACS and its related vital structures. Temporal bone is indeed a gold mine of knowledge for an otologist. Hence, in this one of a kind study done on cadaveric temporal bones and its comparison with the X-ray to assess the morphology and relations of the MACS to its vital structures. This being a rare study depicts the need for such similar studies to study detailed anatomy of the MACS, thus this is one such study which has been done to measure the volume of mastoid cavity and distance between sigmoid plate and posterior wall of EAC and tegmen plate and mastoid tip both anatomically as well as radiologically .

With the need to do a cortical mastoidectomy in our county for quiesent mastoiditis, this study assesses the possible morphological and radiological variations that can exist in the Indian cadavers hoping to add up to the present understanding for the temporal bone dynamics of 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 objective of the study was to co-relation of mastoid air cell system radiologically and anatomically in relation to its morphology in a cadaveric bone.

In this study, we evaluated 30 wet cadaveric temporal bones and measured pre dissection digital Xray mastoid followed by anatomical dissection performing Cortical mastoidectomy followed by post dissection digital Xray mastoid. We measured surface area of mastoid air cell system, shortest length between sigmoid sinus plate and posterior wall of EAC, shortest distance between dural plate and mastoid tip.

- Mean surface area of mastoid air cell system on pre-dissection digital X-ray mastoid was 2.84 mm^3 , volume of mastoid air cell system which was 3.04 cc^3 , mean surface area of mastoid air cell system on post-dissection digital X-ray mastoid was 3.07 mm^3 .
- In our study of 30 temporal bone dissection, the mean Shortest length between sigmoid sinus and posterior wall of EAC in pre dissection x-ray was 20.27 mm , anatomical dissection method was 21.57 mm , post dissection x-ray was 21.63 mm .
- In our study of 30 temporal bone dissection, in pre dissection x-ray the mean of Shortest length between dural plate and mastoid tip was 20.67 mm , anatomical dissection method was 20.90 mm , post dissection x-ray was 22.40 mm .

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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)
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http//www.jnmc.edu
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Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/ 309 **Date: 24/12/2019**

To.
BE0119003
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 AND RADIOLOGICAL CORRELATION OF MASTOID AIR CELLS SYSTEM IN RELATION TO ITS MORPHOLOGY"**, 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.

ANNEXURE II

PROFORMA FOR DATA COLLECTION

PROFORMA

DATE:

Temporal bone number -

Dimensions measured radiologically on digital radiograph .

1. Two dimension surface area of mastoid air cell system __________________

2. Shortest distance between sigmoid sinus and posterior wall of external auditory canal _________________

3. Shortest distance between dural plate and mastoid tip_________________

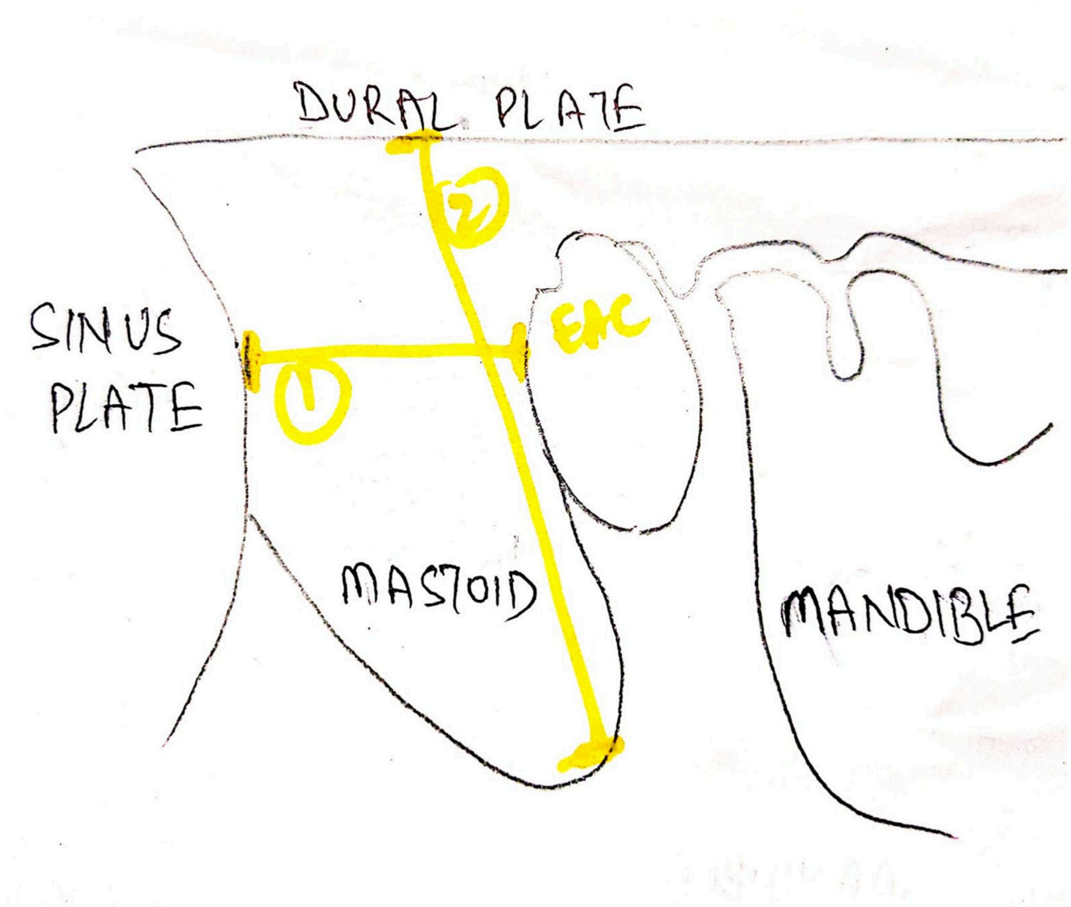
Dimensions measured anatomically using vernier caliper .

1. Volume of mastoid air cell system _____________________

2. Shortest distance between sigmoid sinus and posterior wall of external auditory canal _______________

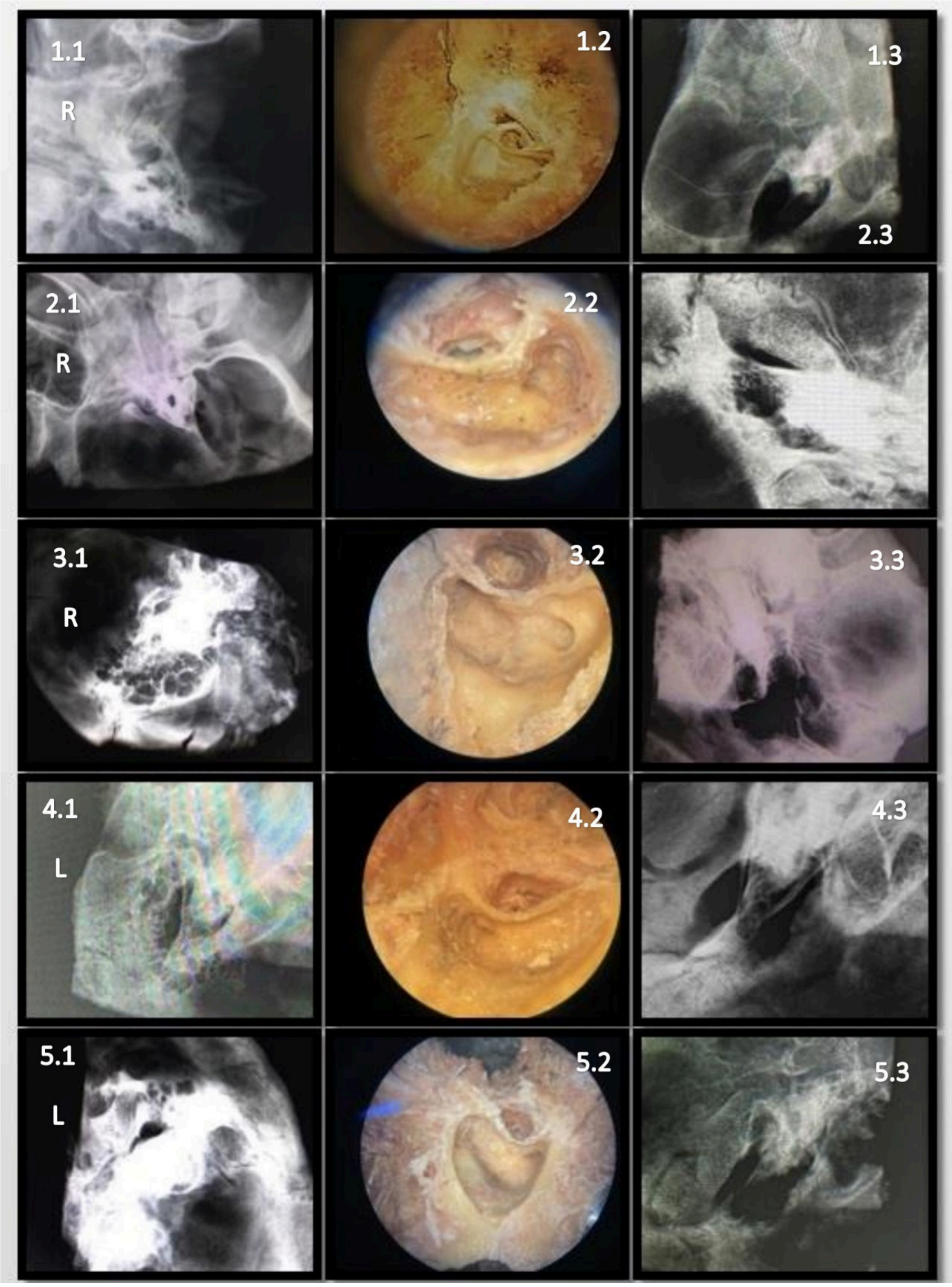
3. Shortest distance between dural plate and mastoid tip_________________

Radiological	**Anatomical**
Surface area =	Volume =
Sigmoid sinus and posterior wall of external auditory canal =	Sigmoid sinus and posterior wall of external auditory canal =
Dural plate and mastoid tip =	Dural plate and mastoid tip =
Sinodural angle=	Sinodural angle=

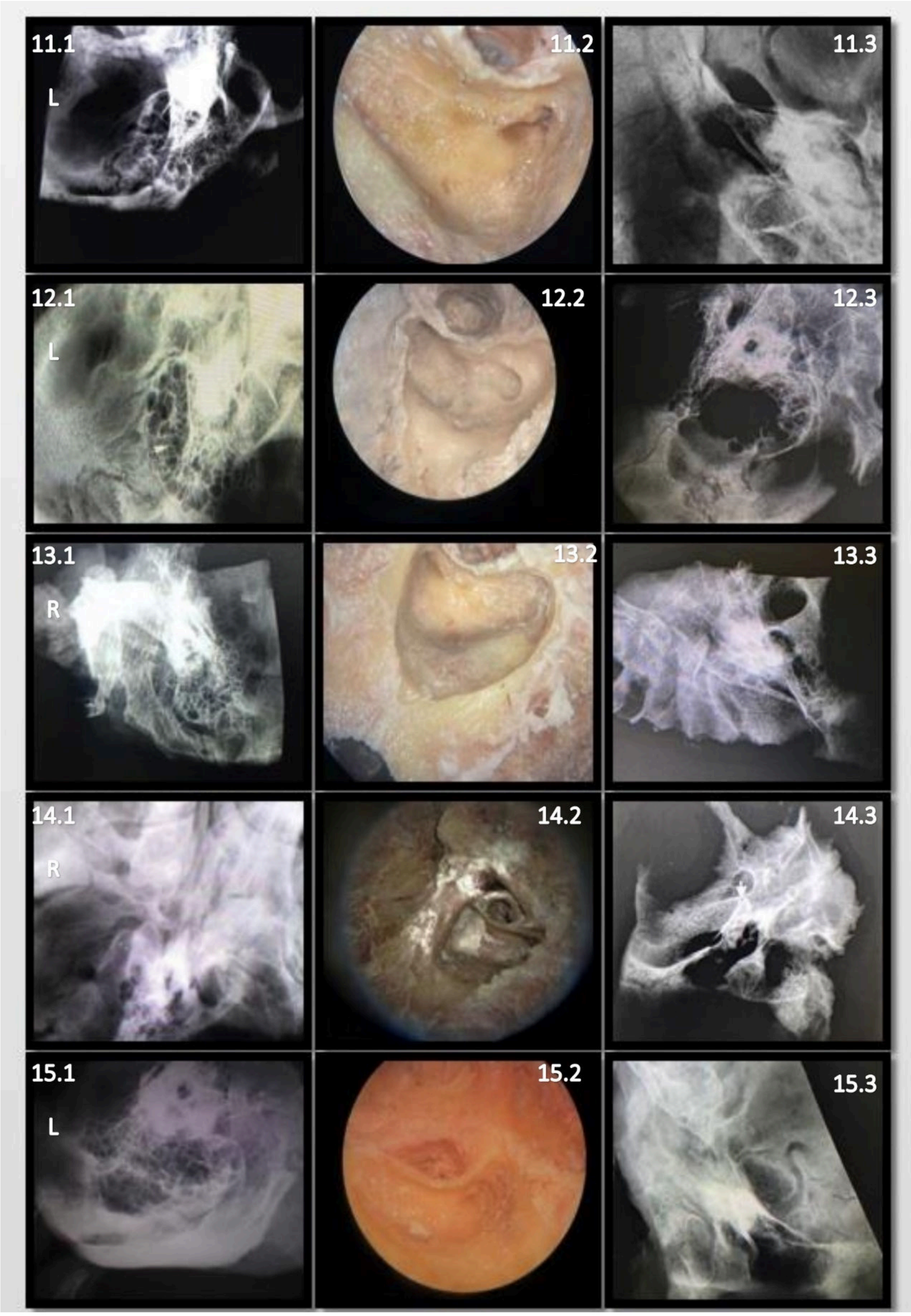

DURAL PLATE
2
SINUS
PLATE
1
EAC
MASTOID
MANDIBLE

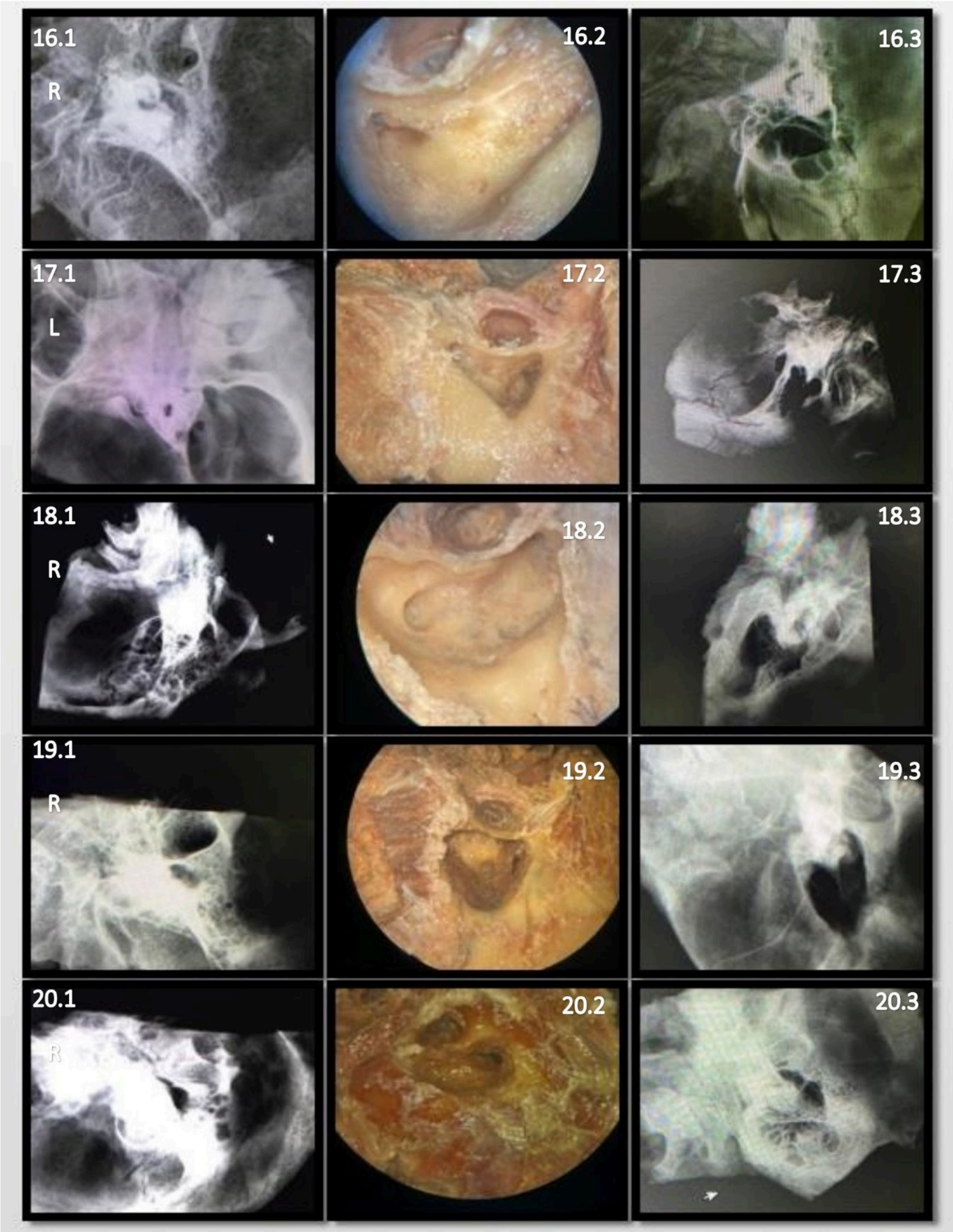
ANNEXURE III

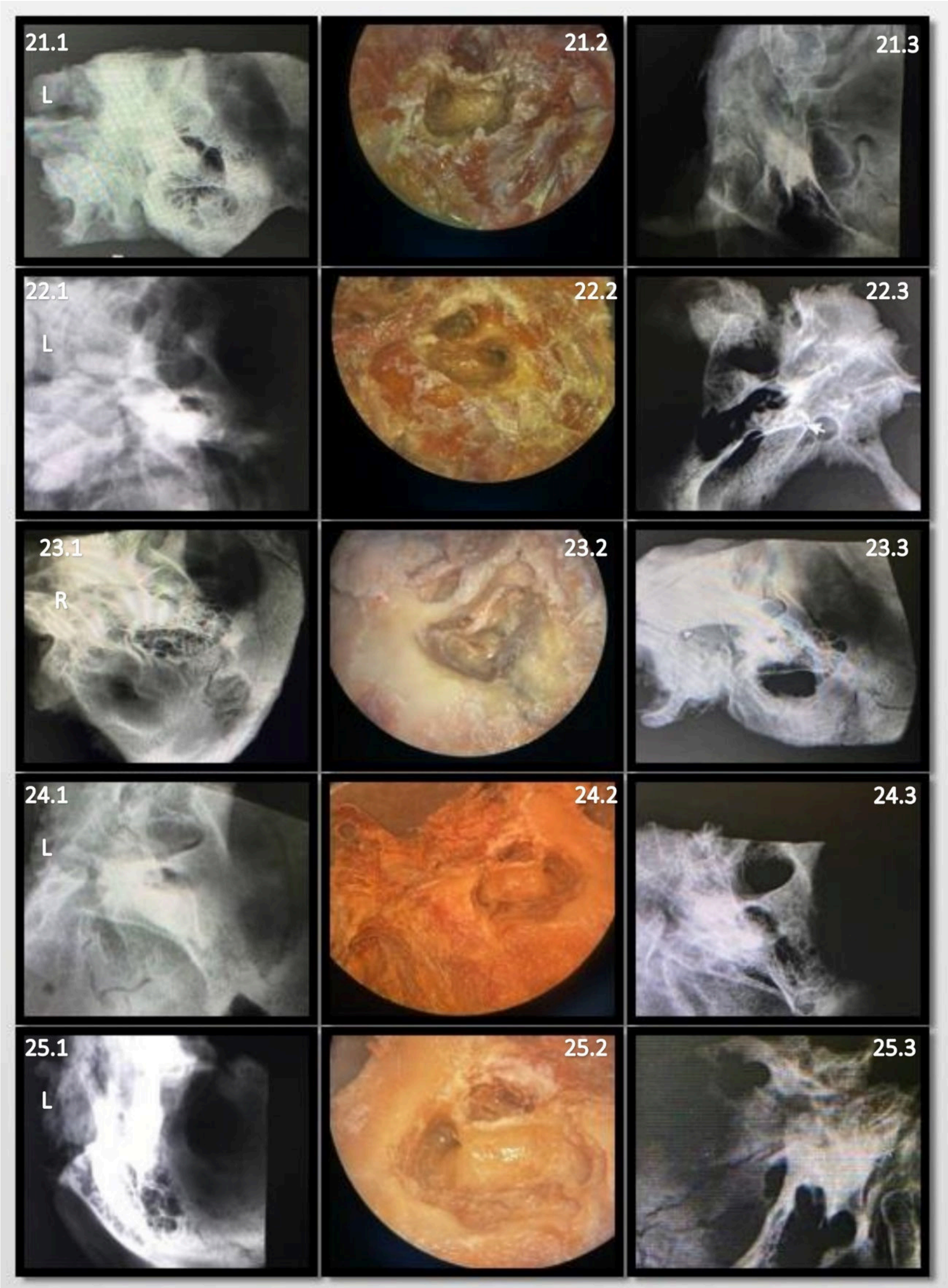
PHOTOGRAPHS

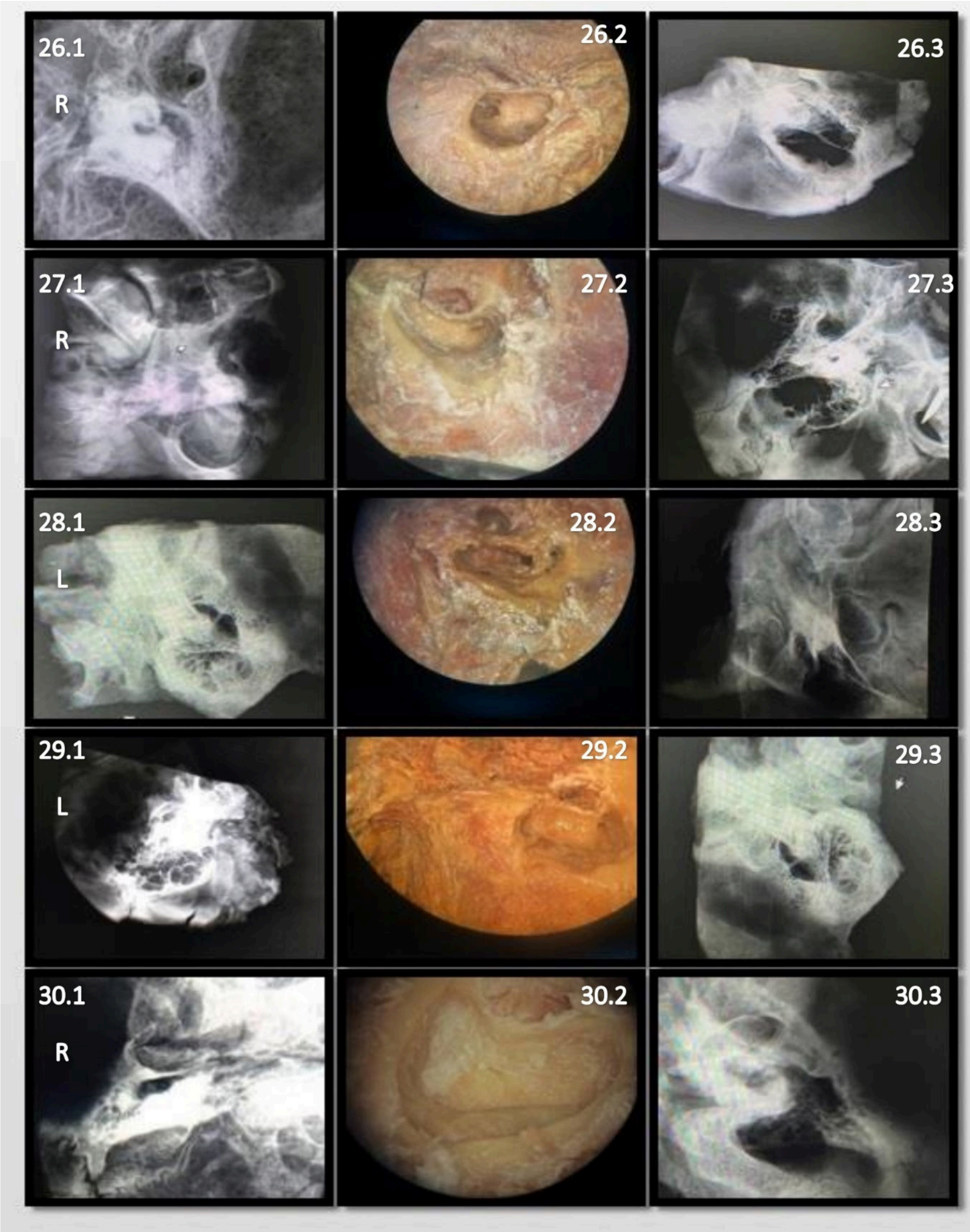



6.1
R
6.2
6.3
7.1
R
7.2
7.3
8.1
L
8.2
8.3
9.1
R
9.2
9.3
10.1
R
10.2
10.3


11.1
L
11.2
11.3
12.1
L
12.2
12.3
13.1
R
13.2
13.3
14.1
R
14.2
14.3
15.1
L
15.2
15.3


16.1
R
16.2
16.3
17.1
L
17.2
17.3
18.1
R
18.2
18.3
19.1
R
19.2
19.3
20.1
R
20.2
20.3


21.1
L
21.2
21.3
22.1
L
22.2
22.3
23.1
R
23.2
23.3
24.1
L
24.2
24.3
25.1
L
25.2
25.3


26.1
R
26.2
26.3
27.1
R
27.2
27.3
28.1
L
28.2
28.3
29.1
L
29.2
29.3
30.1
R
30.2
30.3

ANNEXURE IV

KEY TO MASTER CHART

R - Right

L – Left

Ossicular status

M+ = Malleus present

I+ = Incus present

S+ = Stapes present

I- = Incus absent

S- = Stapes absent

SL NO	TEMPORAL BONE NUMBER	SIDE	PRE DISSECTION RADIOLOGICAL- X-RAYS					ANATOMICAL-TEMPORAL BONE						POST DISSECTION RADIOLOGICAL- X-RAYS		
			SURFACE AREA OF MASTOID AIR CELLS ON XRAY (IN mm3)	SHORTEST DISTANCE BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)	SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP (IN mm)	TYPE OF PNEUMATIZATION	SINODURAL ANGLE X RAY	VOLUME OF MASTOID AIR CELLS (IN cc)	SHORTEST DISTANCE BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)	SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP (IN mm)	OSSICULAR STATUS	TYMPANIC MEMBRANE STATUS	SINODURAL ANGLE DISSECTION	SURFACE AREA OF MASTOID AIR CELLS ON XRAY (IN mm3)	SHORTEST DISTANCE BETWEEN SIGMOID SINUS & POSTERIOR WALL OF EAC (IN mm)	SHORTEST DISTANCE BETWEEN DURAL PLATE AND MASTOID TIP (IN mm)
1	1	R	3.2	17	20	Pneumatic	47	3.9	20	20	M + I+ S+	Intact	49	3.6	18	23
2	2	R	2.6	18	27	Diploic	35	3.1	20	20	M + I+ S+	Intact	34	2.7	18	27
3	3	R	4.2	22	23	Pneumatic	37	5.1	24	23	M + I+ S+	Intact	44	4.7	23	23
4	4	L	3.3	19	16	Pneumatic	42	4	21	19	M + I+ S+	Intact	43	3.7	20	21
5	5	L	1.7	15	14	Sclerotic	28	1.9	16	13	M + I+ S+	Intact	30	1.9	16	16
6	6	R	2.7	19	17	Pneumatic	45	3.1	21	19	M + I+ S+	Intact	45	3.0	21	23
7	7	R	2.4	19	20	Diploic	32	2.4	20	22	M + I+ S+	Intact	34	2.7	20	25
8	8	L	3.1	21	20	Pneumatic	38	2	20	21	M + I+ S+	Intact	40	3.3	22	26
9	9	R	4.2	20	22	Pneumatic	52	4.2	21	22	M + I+ S+	Intact	50	4.6	20	22
10	10	R	1.7	18	17	sclerotic	34	2	18	18	M - I- S+	perforated	35	1.9	21	17
11	11	L	1.9	16	19	sclerotic	31	2	17	18	M - I+ S+	perforated	30	1.9	18	20
12	12	L	3.4	26	21	pneumatic	55	3.8	27	21	M + I+ S+	Intact	56	3.6	26	24
13	13	R	2.8	22	24	Diploic	34	3	24	24	M + I+ S+	Intact	37	2.8	22	24
14	14	R	2.6	19	22	pneumatic	47	2.9	21	24	M + I+ S+	Intact	49	2.7	21	22
15	15	L	3.4	27	25	pneumatic	49	3.4	27	25	M + I+ S+	Intact	50	3.8	29	25
16	16	R	3.8	24	23	Diploic	35	4.1	25	23	M + I+ S+	Intact	32	3.8	23	25
17	17	L	2.7	19	22	pneumatic	47	2.9	22	24	M + I+ S+	Intact	46	2.9	20	22
18	18	R	2.1	17	20	sclerotic	27	2.1	17	21	M - I+ S+	perforated	31	2.4	21	24
19	19	R	3.2	21	24	pneumatic	45	3.5	24	24	M + I+ S+	Intact	47	3.3	21	24
20	20	R	2.4	20	18	sclerotic	33	2.1	21	16	M + I+ S+	Intact	35	2.4	24	21
21	21	L	1.9	16	15	sclerotic	27	1.9	17	17	M + I+ S+	Intact	30	2.5	19	16
22	22	L	2.3	18	19	Sclerotic	31	2.4	19	18	M + I- S+	perforated	33	2.6	21	21
23	23	R	3.5	24	22	Pneumatic	56	3.8	25	22	M + I+ S+	Intact	56	3.5	24	23

24	24	L	2.1	19	16	Sclerotic	37	2.4	21	15	M - I+ S+	perforated	40	2.5	21	18
25	25	L	3.5	23	25	Diploic	42	3.5	24	25	M + I+ S+	Intact	40	3.5	24	26
26	26	R	2.4	22	20	Diploic	39	2.7	23	20	M + I+ S+	Intact	37	2.9	23	20
27	27	R	3.6	25	19	Pneumatic	45	3.4	24	19	M + I+ S+	Intact	42	3.6	26	21
28	28	L	2.1	22	24	Diploic	32	2.4	26	24	M + I+ S+	perforated	33	2.6	25	24
29	29	L	3.5	19	26	Pneumatic	48	3.9	19	28	M + I+ S+	Intact	45	3.5	21	28
30	30	R	2.9	21	20	Pneumatic	54	3.3	23	22	M + I+ S+	Intact	51	3.3	21	21