Dissertation On

USEFULNESS OF PREOPERATIVE HIGH RESOLUTION COMPUTED TOMOGRAPHY IN MIDDLE EAR CHOLESTEATOMA

Submitted for
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CERTIFICATE

This is to certify that DR. S. KUMARESAN is a Post Graduate student during the academic session 2004 to 2007 in Upgraded Institute of Otorhinolaryngology, Government General Hospital ,Madras Medical College,CHENNAI – 600 003

The following dissertation titled USEFULNESS OF PREOPERATIVE HIGH RESOLUTION COMPUTED TOMOGRAPHY IN MIDDLE EAR CHOLESTEATOMA is a bonafide work done by him during the study period and is being submitted to The Tamilnadu Dr.M.G.R.Medical University in partial fulfillment of M.S.(ENT) examination march 2007

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DECLARATION

I, ***DR. S. KUMARESAN*****,** solemnly declare that dissertation titled **"*USEFULNESS OF PREOPERATIVE HIGH RESOLUTION COMPUTED TOMOGRAPHY IN MIDDLE EAR CHOLESTEATOMA*"** is a bonafide work done by me at UIORL Madras Medical College, Chennai. under the guidance and supervision of my unit chief **Prof. S. AMMAMUTHU,M.S., D.L.O.,**

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INTRODUCTION

Cholesteatoma is traditionally diagnosed by otoscopic examination and treated by explorative surgery. The need for imaging in an uncomplicated case is contentious. This study assesses the usefulness of a pre-operative high-resolution CT scan in depicting the status of the middle ear structures in the presence of cholesteatoma.

Cholesteatoma is a sac of keratinising squamous epithelium in the middle ear cleft. The lesion is classically recognised by the presence of attic squames on otoscopic examination. The presence of cholesteatoma must also be suspected beneath polyps protruding from the pars flaccida or when there is a marginal tympanic membrane perforation or granulation. Cholesteatoma is a potentially serious condition as it can progressively enlarge and erode into neighbouring structures, giving rise to serious intracranial and extracranial complications.

Barring any medical contra-indications, treatment of a suspected cholesteatoma is by surgical exploration and eradication of disease with a tympanomastoidectomy operation. Unlike the situation with endoscopic sinus surgery whereby routine pre-operative CT scan is widely accepted as standard practice, the need for pre-operative imaging studies for cholesteatoma is controversial. Even amongst experienced otologists, there is no single accepted standard for the need of CT scan in uncomplicated cases.

The advent of high resolution CT scans (HRCT) has brought about significant enhancement in the preoperative assessment of temporal bone

pathology and fine anatomical details. The intent of this study is to evaluate the accuracy and the usefulness of this imaging modality in our patients undergoing surgery for cholesteatoma.

HRCT provides excellent detail of bony landmarks with in temporal bone due to inherent contrast its dense bone being surrounded by air of the tympanic cavity and mastoid air cells. It has also added a whole new dimension to evaluation of the temporal bone by allowing visualization of the soft tissue components within and adjacent to the temporal bone.

Therefore one of its major contribution to the otologist dealing with the disease is the preoperative localization of the cholesteatoma sac, a detail that not only determine the type of surgical approach but also alert the surgeon to possible intraopeartive and postoperative complications.

AIM

- *To evaluate the efficacy of preoperative HRCT in assessment of disease in patients with middle ear cholesteatoma*

- *To verify pre operative HRCT findings with per operative findings*

- *To provide road map for surgeon in these patients*

- *To provide the surgeon a tool to counsel the patient regarding outcome of surgery*

REVIEW OF LITERATURE

COMPUTED TOMOGRAPHIC ANATOMY

The inner ear structures of temporal bone are oriented to external landmark of the skull ,making it possible to align the section plane to structures that needed to be evaluated .

The temporal bone has a high inherent radiation attenuation contrast ,having both the most dense bone in the body as well as air-filled spaces

AXIAL SECTIONS:

- Made 30 degrees above the anthropologic baseline
- Position ; Supine ,neck slightly flexed.
- Plane ; intersects external auditory meatus and superior orbital rim

STRUCTURES BEST SEEN :

Facial nerve canal, internal auditory canal .vestibular aqueduct, lateral semicircular canal, oval and round windows, incudomalleolar and incudostapedial articulations

CORONAL SECTIONS:

- Made at 105 degrees to the anthropologic baseline
- Position; Prone, neck maximally extended
- Plane; Intersects external auditory meatus and perpendicular to planum sphenoidale and parallel to posterior wall of maxillary sinus

STRUCTURES BEST SEEN:

- Ossicles, geniculate ganglion, oval window, jugular fossa, middle ear walls, and roof (tegmen tympani),internal auditory canal and vestibule.

AXIAL SECTIONS CAUDAD TO CEPHALAD

AXIAL HYPOTYMPANIC JUGULAR FORAMEN LEVEL

FIGURE 1

- The carotid canal lies just anterior to the jugular fossa forming a snowman –like configuration.
- Hypotympanum is adjacent to jugular bulb and carotid canal
- Apex of opening of Eustachian canal extends parallel to carotid canal.
- The petro-occipital fissure separates the temporal and occipital bones.

AXIAL INFERIOR TYMPANIC LEVEL

FIGURE 2

- The anterior and posterior margins of bony external auditory canal show sharp cortical margins.

- The descending facial nerve canal is seen as a well-defined circular lucency posterior to external auditory canal.
- Carotid canal is seen in the anteromedial course parallel to the semicanal for tensor tympani
- The medial funnel shaped cochlear aqueduct is seen as a triangular lucency facing the cerebello pontine angle and may mimic the internal auditory canal . Long process of malleus lies parallel to the tympanic cavity.

AXIAL MID TYMPANIC LEVEL

FIGURE 3

- Highly complex ,but consistent in all patients .
- Normal tympanic membrane not visualized. Long process of malleus lies parallel and anterior to long process of incus .
- Apical ,second ,and basal turns of cochlea are well visualized with the cochlear aqueduct.

AXIAL EPITYMPANIC INTERNAL AUDITORY CANAL LEVEL

FIGURE 4

- Computed tomography displays the ice-cream cone configuration of head of malleus and body of incus .
- The stapes superstructure may be visualized forming an arch over the oval window
- Internal auditory canal is funnel shaped and must be symmetrical. The sinus tympani and descending facial nerve canal are seen lateral and

posterior to the internal auditory canal. Posterior semicircular canal and its ampulla are visualized.

AXIAL SEMICIRCULAR CANAL LEVEL

FIGURE 5

- Vestibular aqueduct is seen as a thin hockey stick shaped lucency
- A H shaped air space is seen ,the anterior part is formed by epitympanic recess , body by mastoid antrum and posterior part by mastoid air cells
- Tegmen tympani may be visualized as a thin plate of bone.
- Medial margin of the antrum is the promontory formed by the otic capsule of the lateral semicircular canal

CORONAL SECTIONS ANTERIOR TO POSTERIOR

ANTERIOR TYMPANIC LEVEL

Figure 6

- Superior and inferior walls of external auditory canal are visualized . Tympanic membrane is seen as a thin filamentous structure extending from scutum superiorly to the limbus inferiorly.
- Head of mallerus is seen in the epitympanic space and the long process of malleus is seen parallel to the tympanic membrane
- The basal and second turn of cochlea and internal auditory canal are seen surrounded by the dense otic capsule

CORONAL MID-TYMPANIC LEVEL

Figure 7

- L-shaped configuration formed by the body of incus and incudostapedial joint with the stapes projecting medially from the body of incus towards the oval window above the cochlear promontory is visualized .
- Proximal limb of geniculate ganglion is seen superior and lateral to the cochlea.
- Horizontal portion of VII nerve is seen as a small circular structure beneath the lateral semicircular canal.

CORONAL OVAL WINDOW LEVEL

Figure 8

- The oval window is seen as a bony defect in the lateral portion of the vestibule.
- Full internal auditory canal including the crista falciformis is visualized.
- The stapes is seen towards the oval window just inferior to the lateral semicircular canal and horizontal portion of VII nerve.

CORONAL POSTERIOR MIDDLE EAR

Figure 9

- Sinus tympani extends between the vestibule and pyramidal eminence . The round window is also visualized .
- The region of posterior genu of VII nerve is seen .
- The styloid process and hypoglossal canal are also visualized.

CORONAL JUGULAR FORAMEN LEVEL

Figure 10

- Jugular foramen and bulb are seen as a dome shaped structure ,the lateral wall of which is lined by mastoid air cells.

- The descending part of VII nerve is seen running vertically down inferior to the lateral semicircular canal.

SURGICAL ANATOMY OF MIDDLE EAR IN RELEVANCE TO CHOLESTEATOMA

Majority of cholesteatoma follow typical patterns of growth dictated by their site of origin and its related anatomic structures.

Common areas from which choleastoma arise

1. Posterior epitympanum
2. Posterior mesotympanum
3. Anterior epitympanum

cholesteatomas spread along pathways formed by mucosal folds, ossicular suspensory ligaments and ossicles themselves.

DEVELOPMENT OF TYMPANIC CAVITY

During 3-7 months of intra uterine life four endothelially lined sacs evaginate from first branchial pouch to form tympanic cavity. Mucosal folds and suspensory ligaments are formed where the sacs contact each other.

SACCUS MEDIUS- splits into 3 saccules

1. MEDIAL- Prussak's space and superior incudal space
2. ANTERIOR- anerior epitympanum
3. POSTERIOR- petrous air cells

SACCUS ANTICUS

1. Anterior portion of middle ear
2. anterior epitympanum

SACCUS POSTICUS

1.Posterior portion of middle ear

2. Hypotympanum

Facial recess, sinus tympani, oval window are derived from the sac

SACCUS SUPERIOR

1.Inferior incudal space

2. Pneumatization of squamous temporal bone

ATTIC OR EPITYMPANUM

- Commonest site for cholesteatoma
- Pars flaccida lacks regular arrangement of middle fibrous layer, hence more prone for retraction
- Ventilation is difficult to maintain after surgery

SUPERIOR - Tegmen tympani
INFERIOR - Tympanic diaphragm
ANTERIOR - COG
POSTERIOR - ADITUS

MEDIAL -Horizontal part of facial nerve
LATERAL - Pars flaccida & scutum

Communicates with mesotympanum through tympanic isthmus.

Tympanic anticus- medial to body of incus, between stapes and tensor tympani tendon.

Tympanic posticus- lies between medial incudal fold and posterior tympanic wall.

EPITYMPANIC SINUS OR ANTERIOR EPITYMPANIC SPACE

Cholesteatoma in epitympanic sinus may not be recognized. It is a cavity of varying size and shape anterior to attic, separated by bony crest coming from tegmen tympani, that is cog.

- SUPERIOR WALL- Tegmen tympani
- ANTERIOR WALL- Bony bridge/tegmen tympani
- MEDIAL WALL - Bone covering facial nerve at geniculate ganglion
- LATERAL WALL- tympanic ring
- INFERIOR BORDER- tensor tympani fold

TYPE A

- Sinus is deep and totally surrounded by bone.

TYPE B

- Bony plate is poorly developed,long tubo tympanic fold.

TYPE C

- No well defined boundaries, tubal recess is large.
- Intact canal wall procedures provides poor access to epitympanic sinus.

POSTERIOR TYMPANUM

Cholesteatoma is difficult to remove in this area. Endaural approach is preferred. There are four sinuses

1. facial sinus
2. lateral tympanic sinus
3. sinus tympani
4. poserior tympanic sinus

- SUPRA PYRAMIDAL- facial sinus /posterior tympanic sinus
- INFRAPYRAMIDAL- lateral tympanic sinus /sinus tympani
- LATERAL TO FACIAL NERVE- facial /lateral tympanic sinus
- MEDIAL TO FACIAL NERVE- sinus tympani/posterior tympanicus

FACIAL SINUS

- Situated at second genu and superior to pyramid
- Can be approached through facial recess.
- Facial recess is a triangle formed by medially facial nerve, laterally chorda tympani, above by fossa incudis.

POSTERIOR TYMPANIC SINUS

Lies medial to facial nerve, superior to ponticus and bridge, and above pyramid.

SINUS TYMPANI

Largest sinus lies inferior to ponticus and extends down to styloid eminence. Inferiorly limited by subiculum. Commonest cause of recurrence is incomplete removal of disease from this hidden area.

PRUSSAK'S SPACE

- Small space lying between neck of mallleus and pars flacida,
- SUPERIOR- Lateral malleolar fold
- INFERIOR- Lateral process of malleus
- MEDIAL - neck of malleus
- LATERAL- pars flaccida

Cholesteatoma spreads through three routes

1. posterior spead into superior incudal space
2. inferior spread to posterior pouch of Von troltsch
3. anterior spread to anterior epitympanum

ANTERIOR POUCH OF VON TROLTSCH

Lies between aneterior malleolar fold and that portion of tympanic membrane anterior to handle of malleus.

POSTERIOR POUCH OF VON TROLTSCH

Lies between posteror malleolar fold and that portion of tympanic membrane posterior to handle of malleus.

FACIAL NERVE AND CHOLESTEATOMA

Cholesteaoma most frequently involves facial nerve in its horizontal portion and second genu. Horizontal segment is just superior to oval window and fallopian canal in this region is frequently dehiscent.

Second genu lies medial to short process of incus and just below lateral semicircular canal. Dissection in floor of fossa incudis and removal of posterior buttress can cause damage to second genu.

Rarely anterior epitympanic cholesteatoma can involve facial nerve at its first genu.

TYPICAL GROWTH PATTERNS OF CHOLESTEATOMA

POSTERIOR EPITYMPANIC CHOLESTEATOMA

Follows embroyologic course of saccus medius

Prussak's space → Floor of prussak's space

↓

superior incudal space ↓

↓ posterior pouch of Von troltsch

aditus ad antrum ↓

↓

mastoid posterior mesotympanum

POSTERIOR MESOTYMPANIC CHOLESTEATOMA

Follows embroyologic course of saccus posticus/superior.

Posterior mesotympanum(facial recess/ sinus tympani) → tympanicus posterior→ inferior incudal space→ aditus→ mastoid

ANTERIOR EPITYMPANIC CHOLESTEATOMA

Follows embryologic course of saccus anticus or anterior saccule of saccus medius.

Anterior epitympanum → supra tubal recess
↓
anterior pouch of Von troltsch

CLASSIFICATION AND PATHOGENESIS

Cholesteatoma may be classified according to presumed etiology into two general categories: congenital and acquired. Acquired cholesteatomas can be further divided into primary and secondary acquired.

Congenital cholesteatomas are thought to arise from embryonal inclusions or rests of epithelial cells. It refers to cholesteatomas present behind an intact tympanic membrane, without continuity to the external ear canal and in the absence of etiological factors such as tympanic membrane perforation and a history of ear infections. They can be further classified according to location within the temporal bone (the petrous pyramid, mastoid and middle ear cleft).

Levenson, et. al., established a set of criteria for the definition of congenital cholesteatoma in the middle ear. These included, (1) a white mass medial to a normal tympanic membrane, (2) a normal pars flaccida and pars tensa, (3) no prior history of otorrhea or perforations, and (4) no prior otologic

procedures. In addition, (5) prior bouts of otitis media were not grounds for exclusion. In their study (over 40 cases), the mean age at presentation was 4.5 years with a male preponderance of 3:1. Two thirds of the cases were confined to the anterior superior quadrant of the middle ear.

Several pathogenic mechanisms have been produced to explain the development of acquired cholesteatomas. No single process is accepted as the mechanism for the development of all cases. However, in all types the keratinizing squamous epithelium has spread beyond its normal limits.

With primary acquired cholesteatomas, the cause is due to underlying Eustachian tube dysfunction resulting in retraction of the pars flaccida. The problem becomes poor aeration of the epitympanic space which draws the pars flaccida medially on top of the malleus neck. Once a retraction pocket develops, the normal migratory pattern of the tympanic membrane epithelium is altered, encouraging the accumulation of keratin. If not addressed, the sac slowly enlarges to and around the ossicles, the attic walls, etc.

The following theories explain secondary acquired cholesteatoma pathogenesis. The implantation theory proposes that squamous epithelium becomes implanted into the middle ear as a result of surgery, foreign body (ventilating tubes), or blast injury. The metaplasia theory explains that as a result of chronic or recurrent otitis media the low cuboidal epithelium of the middle ear becomes transformed to a keratinized stratified squamous epithelium, similar to other parts of the body (nose, sinuses, bronchi) in response to chronic irritation or infection.

The mechanism behind the epithelial invasion or migration theory is that whenever there is a permanent perforation of the tympanic membrane, the squamous epithelium starts migrating along the perforation edge and may continue medially along the undersurface of the drum destroying the columnar epithelium.

It has been proposed that this process is triggered by lingering, chronic infection within the tympanic cavity. Papillary ingrowth refers to the development of cholesteatoma arising from an intact pars flaccida (Shrapnell's membrane). It is theorized that an inflammatory reaction in Prussack's space, likely secondary to poor ventilation in this area, may cause a break in the basal membrane allowing a cord of epithelial cells to start their proliferation inwards.

Management

Cholesteatoma is a surgical disease for which the primary, universally accepted goal is total eradication of cholesteatoma to obtain a safe, dry ear. The second objective is restoration or maintaining the functional capacity of the ear, the hearing. The third objective is to maintain a normal anatomic appearance of the ear if possible. Management of complications when they arise takes priority over other objectives. The surgical procedure to be used should be designed for each individual case according to the pathology present. The extent of disease often will determine the aggressiveness of the surgical approach.

Audiometric Evaluation

Individuals with no residual hearing can be candidates for more radical procedures. With no residual hearing then semi circular canal removal can be done. If no air bone gap is present avoid entering middle ear – Bondy Mastoidectomy.

As with any surgical procedure, preoperative counseling is mandatory. Surgical goals, risks of surgery (facial paralysis, vertigo, tinnitus, hearing loss), possibility of staged procedure, need for long-term follow-up and routine aural toilet if necessary should be reviewed in detail with the patient.

Medical management, including aggressive aural toilet, powder applications, and office local care may exteriorize and safely decompress the accumulating keratin debris. This may be a valid management strategy for patients in whom anesthesia poses an unacceptable risk. Such management is not recommended in children. Preoperatively, it is very important to eliminate drainage and any acute inflammatory changes. This will reduce troublesome intraoperative bleeding and help with the delineation of irreversible disease that must be removed from preservable structures.

Retraction pockets: Tympanostomy tube insertion for ventilation of the middle ear may alleviate early tympanic membrane retraction associated with eustachian tube dysfunction. A long term ventilation tube is often necessary. If the pocket persists despite tube placement, surgical exploration is indicated. Alternatively, excision of the pocket at the time of tympanostomy

tube placement with or without tympanoplasty has been described to prevent development of cholesteatoma and ossicular discontinuity.

Canal-wall-down (CWD) procedures

Prior to the advent of tympanoplasty techniques, all cholesteatoma surgery was of this type. These procedures involve taking down the posterior canal wall to the vertical facial nerve, exteriorizing the mastoid into the external ear canal. The epitympanum is obliterated with removal of the scutum, head of the malleus and incus. A classic CWD operation is the modified radical mastoidectomy in which the middle ear space is preserved. The radical mastoidectomy is a CWD operation in which the middle ear space is eliminated and the eustachian tube plugged. Meatoplasty should be large enough to allow good aeration of the mastoid cavity and permit easy visualization to facilitate postoperative care and self cleaning. The indications for this as an initial approach are:

1) Cholesteatoma in an only hearing ear
2) Significant erosion of the posterior bony canal wall
3) History of vertigo suggesting a labyrinthine fistula
4) Recurrent cholesteatoma after ICW surgery with poor eustachian tube function
5) Sclerotic mastoid (with limited access to the epitympanum)

The advantages of the CWD procedure are that residual disease is easily detected, recurrent disease is rare, and the facial recess is

exteriorized. The major disadvantage of this procedure is the open cavity and that mastoid bowl maintenance can be a lifelong problem. Healing takes longer in open cavities and the middle ear is shallow and difficult to reconstruct. Also, dry ear precautions are necessary.

Intact-canal-wall (ICW) procedure

This procedure was developed to avoid cavity problems altogether. It consists of preservation of the posterior bony external auditory canal wall during simple mastoidectomy with or without a posterior tympanotomy. A staged procedure is often necessary with a scheduled second look operation at 6 to 12 months for removal of residual cholesteatoma and ossicular chain reconstruction. The procedure should be adapted to the extent of disease as well as the skill of the otologist. This approach may be indicated in patients with a large pneumatized mastoid and a well aerated middle ear space, suggesting good eustachian tube function. Intact canal wall procedures are contraindicated in only hearing ears or in the patient with a labyrinthine fistula, long-standing ear disease, or poor eustachian tube function.

The advantages of this procedure compared with CWD mastoidectomies are more rapid healing time, easier long-term care, no water precautions necessary and hearing aids should they be needed are easier to fit and wear. The disadvantages associated with this procedure include the difficulty of technique with more operative time generally, residual disease is

more difficult to detect, retraction pockets leading to recurrent disease are possible, and staged operations are often necessary.

Transcanal anterior atticotomy

This procedure is indicated for limited cholesteatoma involving the middle ear, ossicular chain, and epitympanum. If the extent of the cholesteatoma is unknown, this approach can be combined with an intact canal wall mastoidectomy or extended to a CWD procedure.

The atticotomy involves elevation of a tympanomeatal flap via an endaural incision with removal of the scutum to the limits of the cholesteatoma. After removal of the disease, the aditus is obliterated with muscle, fascia, cartilage or bone prior to reconstruction of the middle ear space. Some advocate reconstruction of the lateral attic wall with bone or cartilage, however, this may lead to retraction disease and possible recurrence in patients with poor eustachian tube function.

Bondy modified Radical Mastoidectomy

Although rarely used today, this is a useful procedure for specific types of cholesteatoma. It is indicated for attic and mastoid cholesteatoma that does not involve the middle ear space and is lateral to the ossicles. Preferably, the mastoid should be poorly developed for creation of a small cavity. The eustachian tube function should be adequate, with an intact pars tensa and aerated middle ear space. The Bondy procedure is performed like

the modern modified radical mastoidectomy with the exception that the middle ear space is not entered.

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Complications of Cholesteatoma

Conductive hearing loss is a common complication of cholesteatoma as ossicular chain erosion occurs in as many as 30% of cases. Erosion of the lenticular process and or stapes superstructure may produce a conductive hearing loss as high as 50dB. However, hearing loss may vary with the development of myringostapediopexy or transmission of sound through a cholesteatoma sac to the stapes or footplate. The ossicular chain should always be assumed to be intact.

Evidence of sensorineural hearing loss may indicate involvement of the labyrinth. Following surgery, 3% of operated ears have further impairment permanently due to the extent of the disease present or due to complications in the healing process. Patient's should be counseled that on occasion there is a total loss of hearing in the operated ear, and with two-staged operations, the hearing will be worse after the 1st operation.

Labyrinthine fistula may occur in as many as 10% of patients with chronic ear infection due to cholesteatoma. A fistula should be suspected in a patient with longstanding disease with sensorineural hearing loss and/or vertigo induced by noise or pressure changes in the middle ear. Absence of a positive fistula test does not rule out this complication. Fine cut CT of the

temporal bone should be obtained. The most common site is the horizontal semicircular canal, although the basal turn of the cochlea is also at risk. The procedure of choice with this complication has been the modified radical mastoidectomy, as discussed previously.

Management of the matrix overlying the fistula depends on the infection status of the ear, degree of hearing loss in the affected and nonaffected ear, size and location of the fistula and surgeon's experience. In an only hearing ear, matrix should be left intact over the fistula. Matrix should also be left over extensive fistulae of the vestibule or cochlea if hearing is normal. Matrix can be removed in a relatively dry, uninfected ear with a normal hearing opposite ear, and the fistula covered with bone pate or fascia.

Facial paralysis in patients with cholesteatoma requires immediate surgery. The paralysis may develop acutely following infection or slowly from chronic expansion of the cholesteatoma. A CT of the temporal bone is obtained which helps localize the involvement. The most common site is the geniculate ganglion from disease in the anterior epitympanum.

A simple mastoidectomy with facial recess approach will expose the tympanic and mastoid portions of the facial nerve, while a middle fossa approach is required with involvement of the petrous apex. Removal of cholesteatoma and infected material with decompression of the nerve usually suffice. Administration of intravenous antibiotics and high-dose steroids are also helpful. Iatrogenic injury to the nerve during surgery should be

immediately repaired with decompression of the nerve proximal and distal to the site of injury.

Intracranial complications of cholesteatoma are potentially life-threatening. Infections such as periosteal abscess, lateral sinus thrombosis and intracranial abscess occur in less than 1% of all cholesteatomas. Findings suggesting an impending intracranial complication include suppurative malodorous otorrhea, usually chronic with headache, pain and/or fever. The presence of mental status changes with nuchal rigidity or cranial neuropathies warrant neurosurgical consultation with urgent intervention. Epidural abscess, subdural empyema, meningitis and cerebral abscesses should be treated immediately prior to definitive otologic management of ear disease.

Review of literature

- **Hassmann-Poznanska E, Goscik E, Olenski J, Skotnicka B**.

  The preoperative CT scans were compared with the operative findings in retrospective analysis of 60 ears operated between 1998-2001. Their results show good radiosurgical correlation in cholesteatoma for most middle ear structures except for the integrity of long process of incus. The disadvantage of CT scans is inability to distinguish between cholesteatoma, granulation tissue and effusion.

- **Fuse T, Aoyagi M, Koike Y, Sugai Y.**

  This study was conducted to assess the usefulness and limitations of high-resolution CT for diagnosing the ossicular chain in the middle ear. Preoperative CT findings of the ossicular chain were compared with operative findings in 26 patients with ossicular defects. Preoperative detection of the complete defect of the malleus head and the body and long process of the incus by high-resolution CT was possible in all cases, while detection of the defect of the manubrium of the malleus and superstructure of the stapes could be made in 33.3 and 60%, respectively. The defect of the incudostapedial joint (1 case) and partial defect of the stapes crus (2 cases) could not be diagnosed correctly by preoperative estimation.

- **Walshe P, McConn Walsh R, Brennan P, Walsh M.**

  Twenty patients awaiting mastoid surgery for chronic suppurative otitis media underwent preoperative high resolution computerized tomography (CT) of the temporal bones. CT was helpful in determining the anatomy of the middle ear and mastoid, and accurately predicted the extent of the disease process in the sinus tympani and facial recess.. This suggests that routine preoperative CT scanning of patients before uncomplicated virgin mastoid surgery is of questionable value

- **Zhang X, Chen Y, Liu Q, Han Z, Li X.**

  The surgical findings of 51 ears operated on were retrospectively compared with the CT findings. The followings were analysed: diagnostic features of chronic otitis media (COM) on CT status of the middle ear structures (ossicles, facial nerve canal, semicircular canals and tegmen tympani), and anatomical variations. RESULT: The radio-surgical agreement was excellent for the malleus (kappa statistics, k = 0.840) and tegmen (0.788), good for the incus (0.700) and semicircular canals (0.56), but poor for the stapes (0.366) and facial nerve dehiscence (0.310. High-resolution CT scan should be a routine examination prior to middle ear and mastoid surgery.

- **Jackler RK, Dillon WP, Schindler RA**.

  Forty-two patients with chronic otitis media underwent preoperative CT scanning followed by surgical exploration of the middle ear and mastoid.. By contrast, the total absence of abnormal soft tissue on CT essentially excluded cholesteatoma. However, 50% of all soft tissue on CT scan not accompanied by bone erosion. In this largest group of patients it was not possible to diagnose or exclude cholesteatoma on the basis of CT findings alone. Also, CT occasionally gave the erroneous impression of lateral semicircular canal fistulization, tegmen tympani erosion, and facial nerve involvement due to volume averaging of these structures with adjacent soft tissues. CT scan has a

role in the evaluation of selected patients with chronic otitis media, but must be interpreted cautiously in view of its limitations and numerous pitfalls.

- **Leighton SE, Robson AK, Anslow P, Milford CA**.

  CT imaging of the temporal bone is highly predictive of the presence of cholesteatoma but its value in the routine management of cholesteatoma has not been assessed. They aimed to establish the indications for CT imaging in CSOM by a prospective study of patients suspected of having cholesteatoma. The patients were assessed clinically and a management plan chosen; this was later adjusted, if indicated, on the basis of radiological findings. Surgical findings were recorded and correlation with CT appearances evaluated. Twenty patients completed the study. CT altered the management plan in 10 and was considered helpful in a further 6. They recommend its routine use in children, medically unfit patients, only or better hearing ears, patients in whom the tympanic membrane cannot be adequately visualized, patients who have had previous mastoid surgery whose operative records are available and patients with intratemporal or intracranial complications of disease

- **Banerjee A, Flood LM, Yates P, Clifford K.**

  Doubts about sensitivity and specificity, in detecting the extent of underlying pathology and in predicting asymptomatic complications,

prevent widespread adoption. This retrospective study looks at the influence of pre-operative scanning on the surgical management of chronic suppurative otitis media over an 18-month period. The radiological findings determined the choice of surgical approach, but contributed less to the decision to operate and the prediction of potential hazards. CT is of most value when the otologist can be flexible in surgical technique, tailoring it to imaging findings.

- **O'Donoghue GM, Bates GJ, Anslow P, Rothera MP.**

  High resolution computerized tomographic scanning was used in the preoperative evaluation of 50 patients with chronic suppurative ear disease. With the exception of the long process of the incus and the stapes superstructure, the state of the ossicular chain was correctly predicted in over 90% of cases. Erosion of the labyrinth was clearly depicted in 4 of the 5 cases in which it occurred. A correct pathological diagnosis was made radiologically in 44 cases (88%).

- **Gaurano JL, Joharjy IA**.

  A retrospective review of CT scans and surgical and histopathological reports in 64 patients with middle ear cholesteatoma (35 male, 29 female; age range, 7-80 years, median age, 22 years). CT scans were evaluated for the presence of intra-tympanic non-dependent soft tissue density, the extent of middle ear involvement, bone expansion and thinning, and bone erosions involving the ossicles and adjacent

structures. Fifty-nine (92%) had expansion of the aditus and mastoid antrum, 59 (92%) had erosions of the ossicles, with involvement of the long process of the incus in 48 (75%), 55 (86%) had an eroded scutum, 55 (86%) an eroded facial nerve canal, 57 (89%) an eroded Koerner's septum, which was totally destroyed in 19 (27%), 48 (75%) had tegmen erosion, and 63 (98%) had erosions of the antral walls. The correlation of pre-operative CT with surgical and histopathological findings was 97%.. These findings should alert the clinician to the possibility of cholesteatoma, which will guide in the surgical approach and treatment plan

- **Zelikovich EI.**

The analysis of 51 CTs of the temporal bone in patients aged from 2 to 74 years with otitis media purulenta chronica, cholesteatoma has established that cholesteatoma of different location and severity has specific CT-symptoms. A reliable diagnostic key to CT-diagnosis of cholesteatoma is attic deformation due to destruction of the lateral wall by a soft tissue lesion, extension of the aditus to the antrum, the presence of the cavity with sclerotic walls in the antromastoid area, carious changes in the auditory ossicles, medial or lateral shift of the ossicles..

- **Chee NW, Tan TY.**

  The surgical findings of 36 ears with cholesteatoma operated on by the first author were retrospectively compared with the CT findings reported on by the second author. The following were analysed: diagnostic features of cholesteatoma on CT, status of the middle ear structures (ossicles, facial nerve canal, semicircular canals and tegmen tympani), and presence of any anatomical variations and disease complications.. The radiosurgical agreement was excellent for the malleus (kappa statistics, k=0.83), stapes (0.94) and semicircular canals (0.8), good for the incus (0.62) and tegmen (0.65), but poor for the facial nerve canal (0.3)..: There is good to excellent radiosurgical correlation in cholesteatoma for most middle ear structures except for the integrity of the facial canal.

- **Yates PD, Flood LM, Banerjee A, Clifford K.**

  The history of surgery for middle ear cholesteatoma is of an evolution of techniques to meet the challenges of inaccessible disease and of post-operative cavity management. The concept has traditionally been of exploration guided by awareness and anticipation of all, possibly asymptomatic, complications. Modern imaging reliably demonstrates surgical anatomy, dictating the ideal approach, forewarns of complications and may reveal the extent of disease. An apparent resistance amongst otologists to universal CT scanning prior to

mastoidectomy contrasts with the enthusiasm of skull base surgeons or rhinologists for appropriate imaging

- **Zelikovich EI.**

  Computed tomography (CT) of the temporal bone has been used to study thirty-eight 5-72-year-old patients with otitis media chronica purulenta (OMCP), in 14 of them the process was bilateral. The analysis of 52 CTs of the temporal bone with consideration of otoscopic and operative findings helped to distinguish CT signs of non-cholesteatomic OMCP. These signs include sclerotic alterations of the bone tissue of the mastoid process (82.7%), defective pneumaticity of the middle ear cavities (tympanic cavity - 80.7%) due to pathological substrate, destructive changes of the auditory bones (50%), carious alterations of the walls of the middle ear cavities (21%).

- **Koster O, Strahler-Pohl HJ.**

  In thirty patients with cholesteatomas of the middle ear, high resolution CT of the petrous bone was performed in conjunction with the clinical examination.. Typical complications such as destruction of the auditory ossicles, the bony labyrinth, the facial canal, the lateral wall of the attic and the superior and inferior walls of the tympanic cavity are clearly demonstrated. Using the high contrast and special resolution of modern high resolution CT, this has become the method of choice in the investigation of cholesteatomas of the middle ear.

MATERIALS AND METHODS

A total of 30 patients of whom 14 were males and 16 were females were studied. Age group varied from 9 to 50 years.

Patients were selected from out patients clinic and wards of Otorhinolaryngology , Government General hospital, Chennai.

Patients were selected on the basis of their symptoms and clinical findings and after informed consent subjected to HRCT SCAN before surgery.

INCLUSION CRITERIA

Patients with unsafe ear

1. Cholesteatoma detected by otoscopy
2. Marginal tympanic membrane perforation
3. Posterosuperior retraction and granulation
4. History of scanty purulent blood stained foul discharge

EXCLUSION CRITERIA

1. Patients with known intracranial / intratemporal complications
2. Patients undergone previous mastoid surgery

All the examinations were performed on a Toshiba asteion spiral CT scanner.

Patients were scanned in two planes , one axial at 30 degree with patient placed supine with head flexed and the scan plane passing through the external auditory canal and superior orbital rim.

Coronal sections were performed with the patient placed prone with neck maximally extended. The scan plane was oriented to intersect the external auditory canal parallel to the posterior margin of the maxillary sinus.

The pre-surgical HRCT scans were retrospectively assessed, by the radiologist for the following radiological features of cholesteatoma: (a) the presence of a non-dependent tissue mass, (b) location of the pathology in a position typical for cholesteatoma, i.e. the epitympanum and mastoid antrum, and (c) presence of bony or ossicular erosion. In addition, being blinded to the surgical findings, the radiologist was asked to comment on the state of the ossicles (malleus, incus and stapes), the integrity of the facial canal, semicircular canals and the tegmen tympani, and any anatomical variations and disease complications that were present.

Surgeries were done in the ENT operation theatre under microscope barring two cases in which endoscope was used .Peroperative findings were recorded

The operative findings were reviewed retrospectively and compared with the radiological findings.

PARAMETERS APPLIED:

- A 512X512 Matrix
- FOV 15to 20 cm
- Slice thickness of 1 mm
- 120Kv , 100 mA exposure
- pitch –1
- Magnification factor of 1.7 to 2 used for visualization of both temporal bones
- Magnification factor of 3.5 used for evaluating a single temporal bone in great detail
- Bone algorithm used for image reconstruction

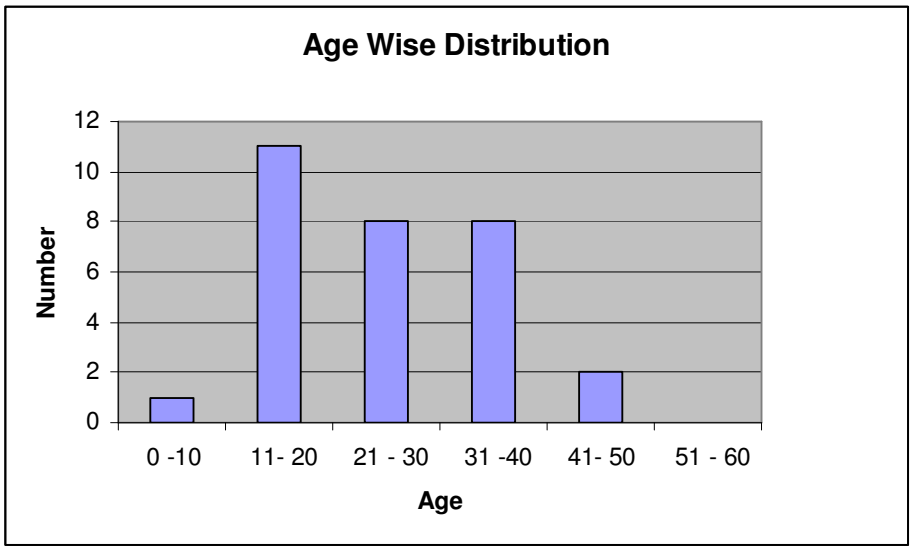
The features evaluated were

- Erosion and destruction of the lateral attic wall (scutum)
- Widening of aditus ad antrum as the destruction extends into the antrum
- Displacement of the ossicles
- Destruction of the ossicles
- Fistula formation with the lateral and posterior semicircular canals and the vestibule
- Erosion into the facial canal
- Dehiscense of the tegmen tympani
- Destruction of the mastoid (automastoidectomy)
- Dehiscense of the sigmoid plate
- Erosion and sagging of the external canal roof

RESULTS AND ANALYSIS

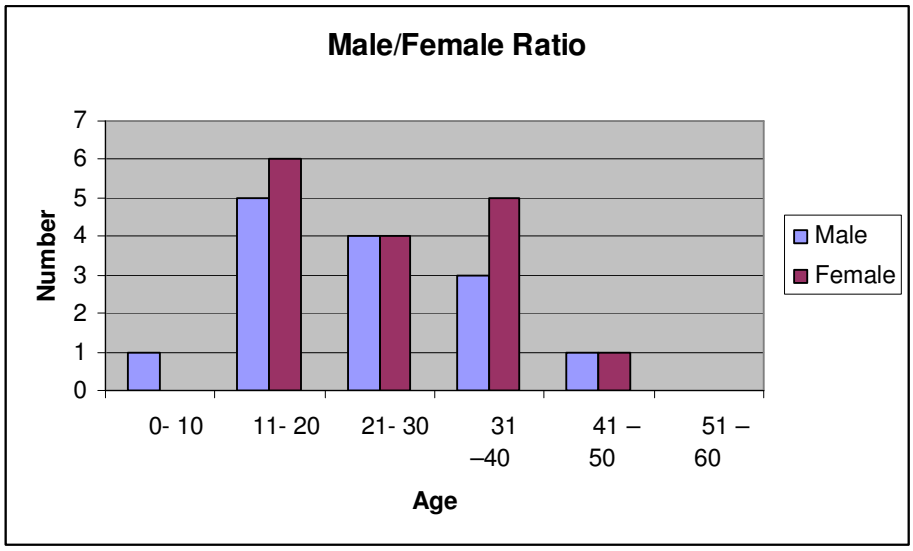
AGE WISE DISTRIBUTION

Age group (years)	N = 30	% of cases
0 -10	1	3.3
11- 20	11	36.6
21 - 30	8	26.6
31 -40	8	26.6
41- 50	2	6.6
51 - 60	0	0



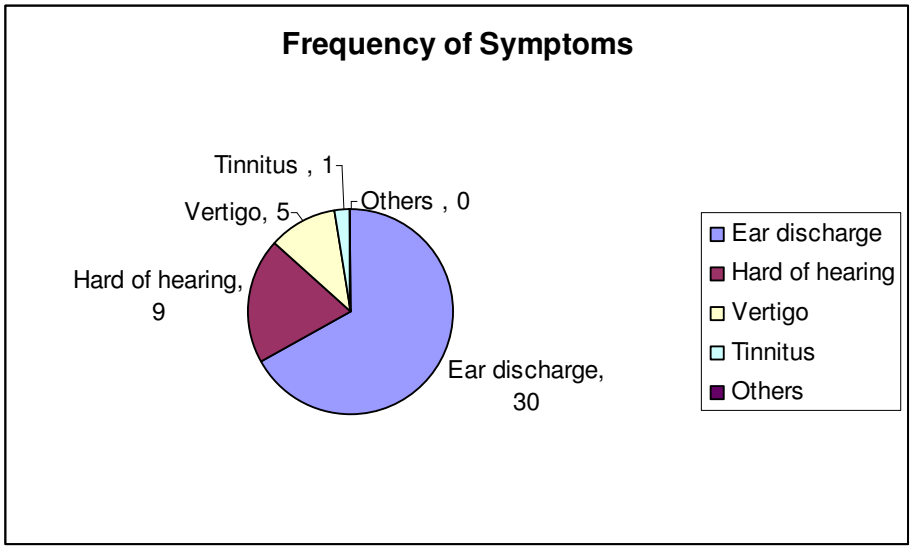
SEX WISE DISTRIBUTION

Age group(years)	Male	Female
0- 10	1	0
11- 20	5	6
21- 30	4	4
31 –40	3	5
41 – 50	1	1
51 – 60	0	0



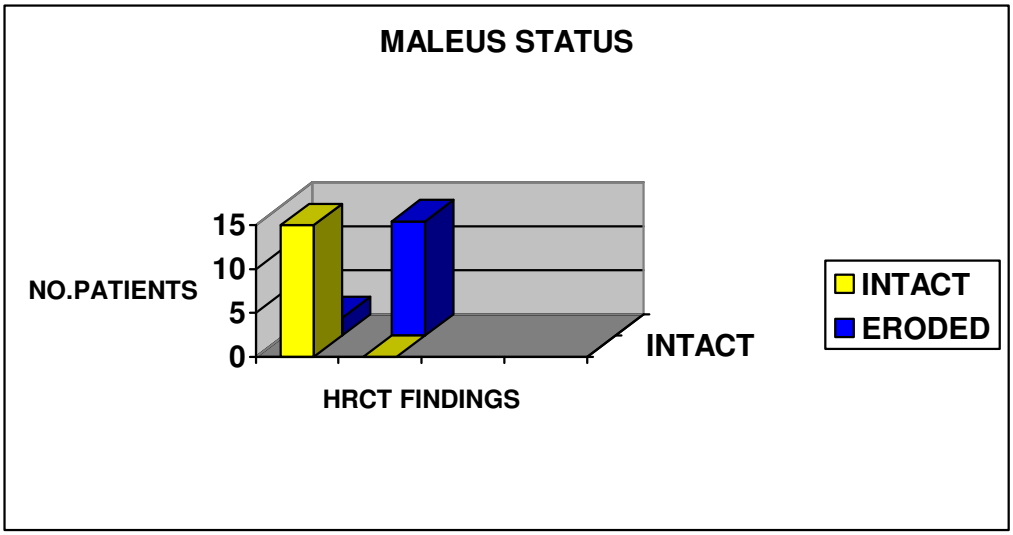
CLINICAL SYMPTOMS IN DECREASING ORDER OF FREQUENCY

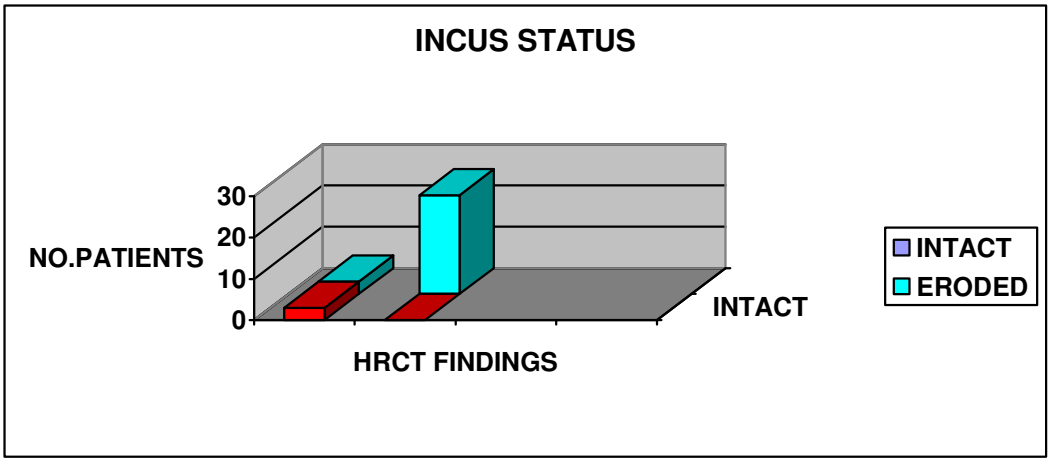
Symptoms	Frequency
Ear discharge	30
Hard of hearing	9
Vertigo	5
Tinnitus	1
Others	0

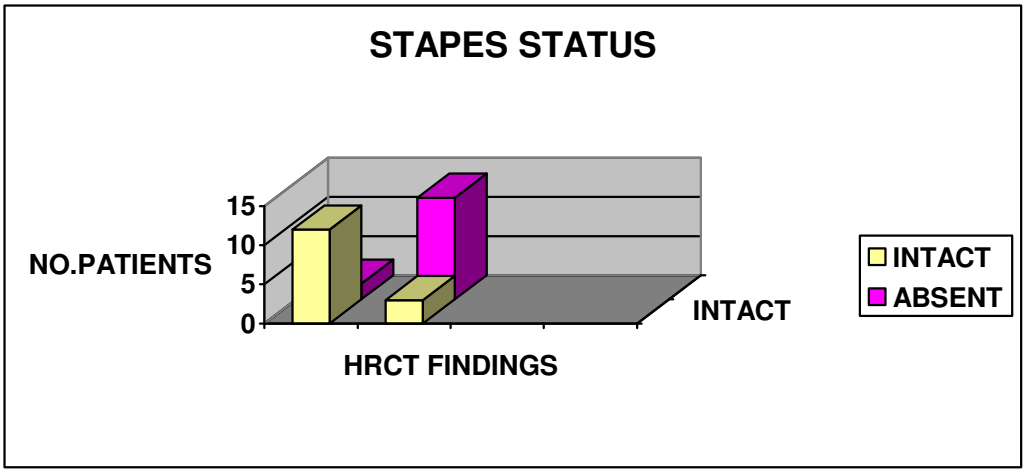


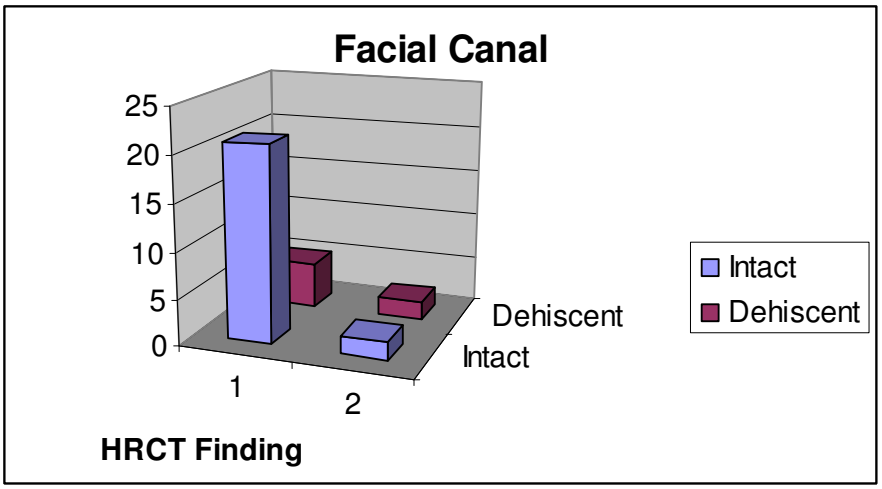
	Surgical Finding	Radiological Findings		Kappa
		Intact	Abnormal	
Malleus	Intact	15	0	0.867
	Eroded	2	13	
Incus	Intact	3	0	0.527
	Eroded	3	24	
Stapes	Intact	12	3	0.667
	Absent	2	13	
Facial canal	Intact	21	2	0.379
	Dehiscent	4	3	
Labryinth	Intact	25	1	0.712
	Fistula	1	3	
Tegmen	Intact	25	1	0.712
	Eroded	1	3	

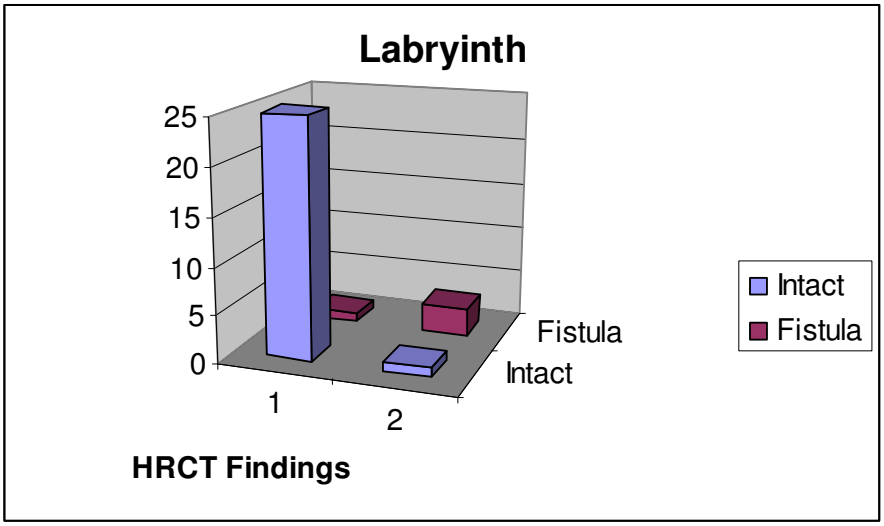
Kappa statistics was used to measure the degree of agreement between surgical and radiological findings. Kappa values exceeding 0.75 represented excellent agreement, values between 0.4 and 0.75 fair to good agreement, and values less than 0.4 poor agreement.

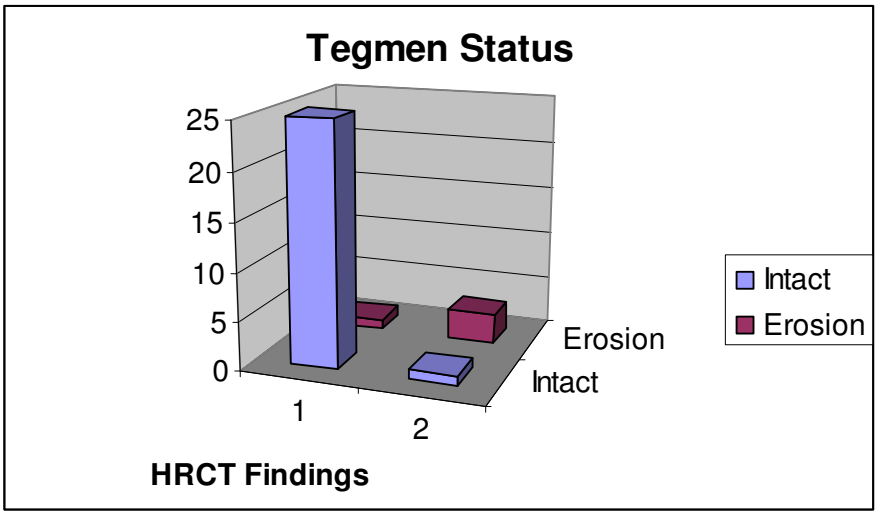

MALEUS STATUS
NO.PATIENTS
15
10
5
0
INTACT
HRCT FINDINGS
INTACT
ERODED


INCUS STATUS
NO.PATIENTS
30
20
10
0
INTACT
HRCT FINDINGS
INTACT
ERODED

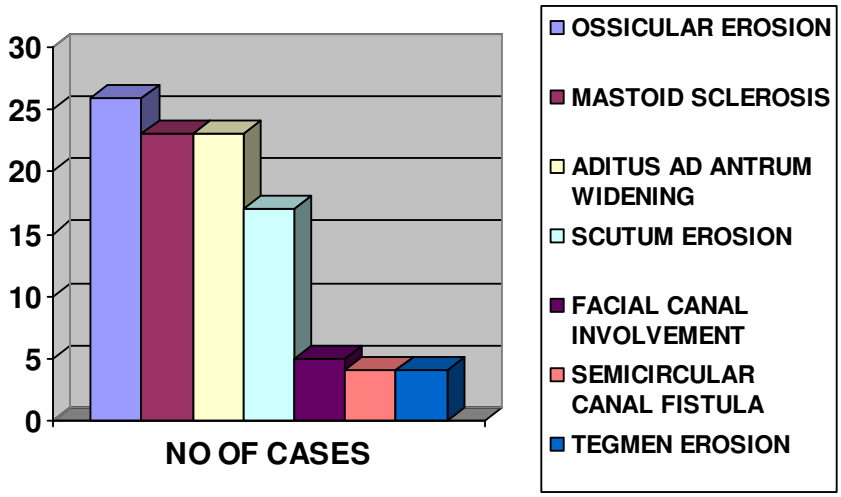

STAPES STATUS
NO.PATIENTS
15
10
5
0
INTACT
HRCT FINDINGS
INTACT
ABSENT


Facial Canal
25
20
15
10
5
0
1
2
Dehiscent
Intact
Intact
Dehiscent
HRCT Finding


Labryinth
25
20
15
10
5
0
1
2
Fistula
Intact
Intact
Fistula
HRCT Findings


Tegmen Status
25
20
15
10
5
0
1
2
Erosion
Intact
Intact
Erosion
HRCT Findings

CT FINDINGS	NO OF CASES
OSSICULAR EROSION	26
MASTOID SCLEROSIS	23
ADITUS AD ANTRUM WIDENING	23
SCUTUM EROSION	17
FACIAL CANAL INVOLVEMENT	5
SEMICIRCULAR CANAL FISTULA	4
TEGMEN EROSION	4



RESULTS

The HRCT scans showed the presence of a nondependent tissue mass in 28 of the 30 cases The location of the pathology on the scan was typical for cholesteatoma in 28 cases and in 27 cases there was radiological evidence of destruction of the bony walls of the middle ear, mastoid antrum or ossicles. All cases had at least 1 of the above radiological features, and 25 cases showed all 3 features. The radio-surgical correlation of the middle ear structures is shown in Table I. The correlation was found to be excellent for the malleus, stapes, and semicircular canals, good for the incus and tegmen tympani, but poor for the facial nerve canal.

State of the ossicles

The incus was the most frequently eroded ossicle, followed by the malleus and the stapes. Out of the 27 incus which were found at surgery to be eroded,24 are demonstrable with the scan. Of the15 eroded malleus, 13 were seen by the scan, while 13 out of 15 cases of absent stapes suprastructure were correctly predicted by imaging.

Semicircular Canal Fistula

There were 4 patients with surgically confirmed labyrinthine fistula. All 4 involved the lateral semicircular canal. Three of the 4 cases were visible in the pre-operative scans, while the remaining case showed thinning of the otic capsule but with no discernible fistula on the scan. In the remaining 26

cases where the semicircular canals were intact clinically, the CT scan was incorrect in one case.

Erosion of Tegmen Tympani

Three patients had erosion of tegmen exposing dura and this was shown with the scan. Of the remaining 27 cases, the scan misread 1 case as having tegmen dehiscence when there was not any.

Facial Canal Dehiscence

Out of the 7 cases with surgically confirmed facial canal dehiscence, only 3 could be detected by the radiologist. In 23 cases, the facial canal was found during surgery to be intact, but the scan suggested possible erosion in 2 of these cases. In addition to the above findings of dehiscent facial canal, labyrinthine fistula and tegmen erosion, various other congenital anatomical variations and surgical hazards were detected in the course of reviewing the scans and included:

a) Erosion of posterior canal wall

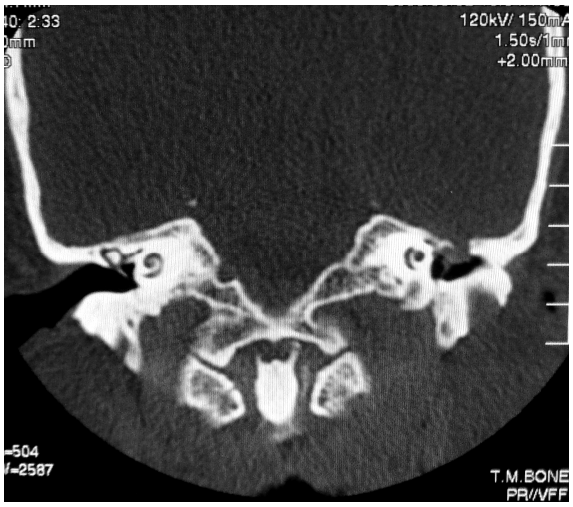
b) Erosion of sinus plate

c) High and dehiscent jugular bulb

d) Anteriorly lying sigmoid sinus

e) Low lying dura

REPRESENTATIVE CASES

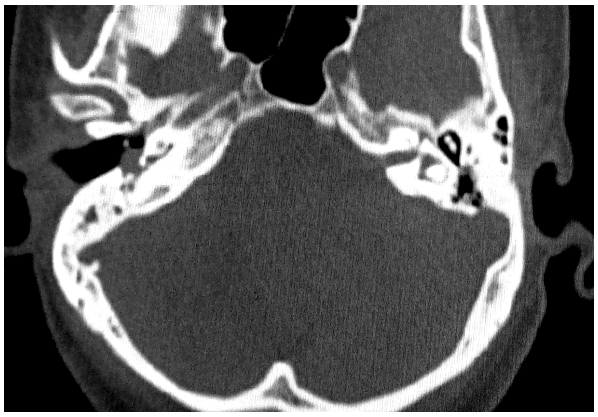


CT CORONAL SECTION SHOWING

DESTRUCTION OF OSSICLES

TEGMEN TYMPANI DEHISCENCE

FIG 11



CT AXIAL SECTION SHOWING

SINUS TYMPANI DEHISCENCE

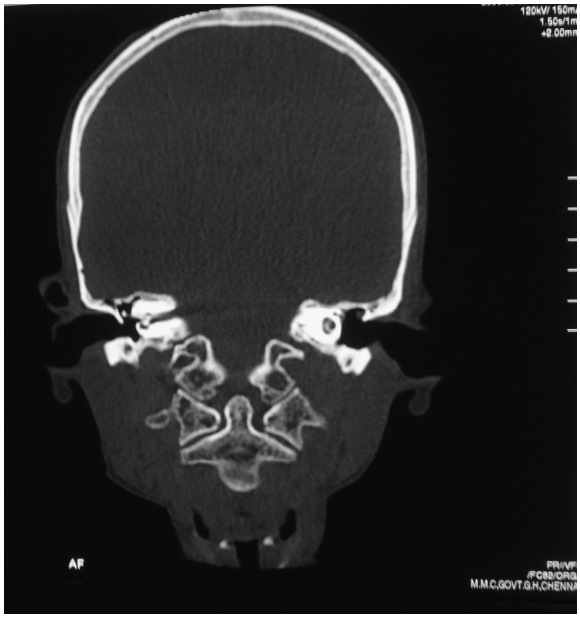
FIG 12

CT CORONAL SECTION SHOWING
SCUTUM EROSION

MALLEUS DESTRUCTION

MEDIAL DISPLACEMENT OF INCUS

FIG 13

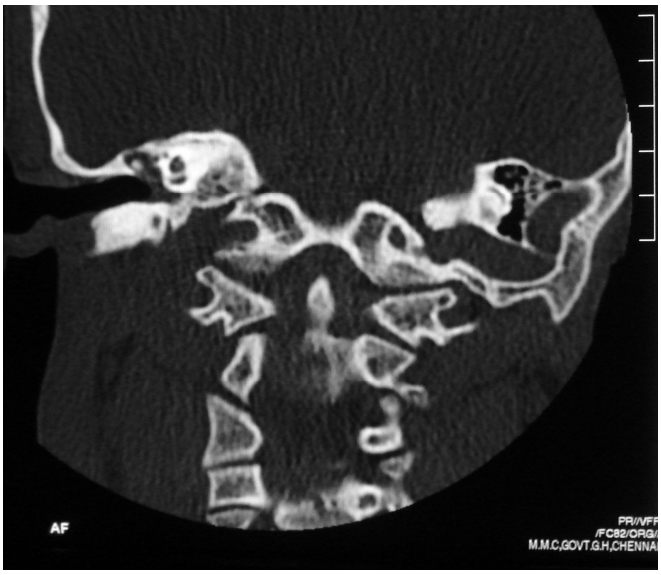


CT CORONAL SECTION SHOWING

SCUTUM BLUNTING

DESTROYED OSSICLES

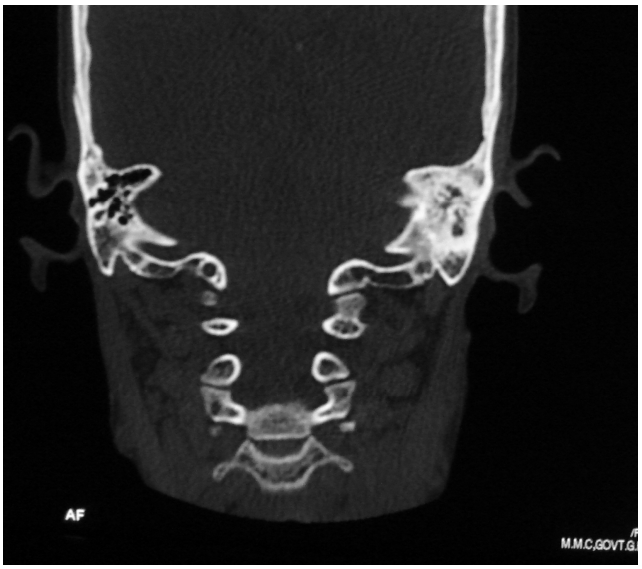
FIG 14



CT CORONAL SECTION SHOWING

LATERALLY DISPLACED MALLEUS

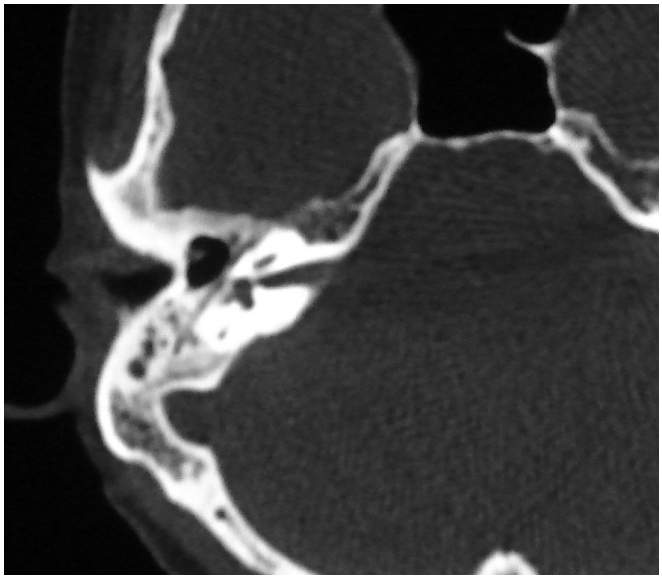
FIG15



CT CORONAL SECTION SHOWING

MASTOID SCLEROSIS

FIG 16



CT AXIAL SECTION SHOWING

FACIAL CANAL

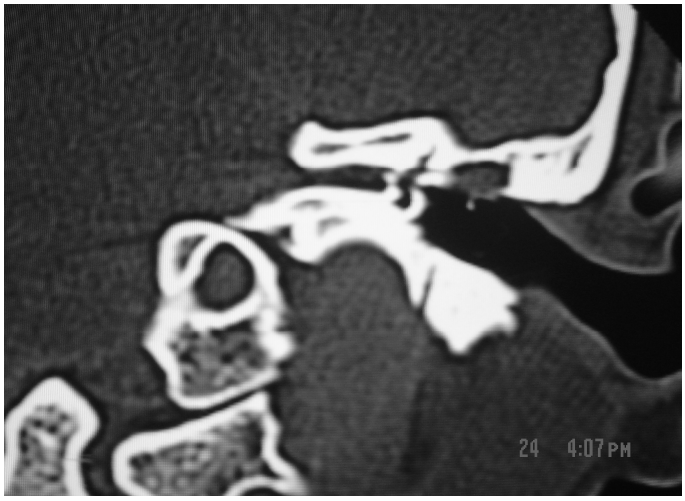
DEHISCENCE

FIG 17

CT CORONAL SECTION SHOWING

FACIAL CANAL DEHISCENCE WITH SOFT TISSUE LESION IN TYMPANIC CAVITY

FIG 18



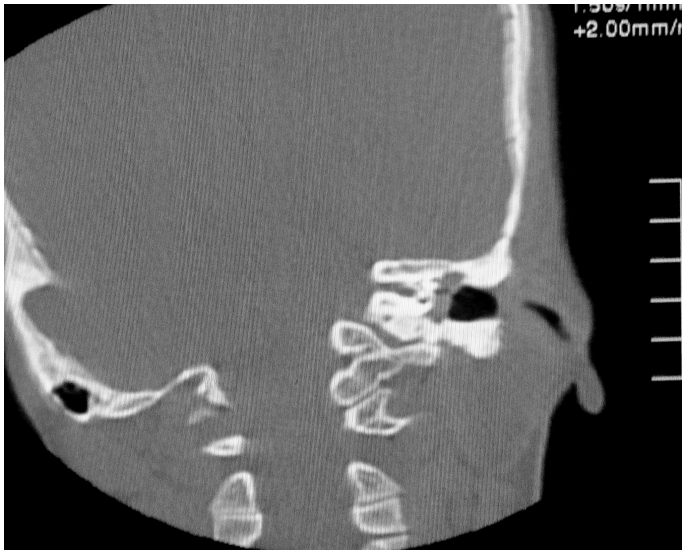
CT CORONAL SECTION SHOWING NON DEPENDENT SOFT TISSUE LESION WITH SCUTUM EROSIN

FIG 19

CT AXIAL SECTION SHOWING

WIDENING OF ADITUS AD ANTRUM WITH EROSION OF ANTRAL WALL

FIG 20



CT CORONAL SECTION SHOWING LATERAL SEMICIRCULAR CANAL FISTULA

FIG 21

DISCUSSION

Cholesteatoma can be accurately diagnosed by the HRCT scan in the vast majority of cases. Mafee et alreported in his series of 48 patients with cholesteatoma that 46 of them (96%) were diagnosed correctly with the pre-operative CT scan. All our cases exhibited at least 1 of the radiological features that we associate with cholesteatoma, i.e. tissue mass, typical locationand bone erosion, and 25 cases had all the 3 features. When we base our diagnosis of cholesteatoma on the scan having at least 2 of the 3 features, all cases would be correctly diagnosed with cholesteatoma. However further study comparing the scan findings of cholesteatoma to other middle ear pathologies would be needed to determine the specificity of these radiological criteria. Also, one should be careful of the limitation of CT to pick out early or limited diseases, since it is difficult to diagnose cholesteatoma on the scan if the soft tissue mass is not associated with bone erosion.

While a definitive diagnosis of cholesteatoma can only be made at the time of surgery, the scan picture may at times influence the decision and timing of surgical exploration. Scan evidence of cholesteatoma with significant bony destruction or other complications could prompt the surgeon to operate earlier, particularly if polyps or a tortuous bony canal obscures visualization of the tympanic membrane and hinders clinical diagnosis. On the other hand, the threshold to explore the ear may be higher when the scan is non-confirmatory, particularly if the patient has medical risks for surgery.

The HRCT scan gives a good to excellent radiosurgical correlation for the middle ear ossicles in our cases, and this is also the experience that others have reported.While prior knowledge of the state of the ossicles is probably not critical insofar as the operative risk is concerned, it has bearing on the likelihood of hearing preservation that can be achieved after surgery. For example, the hearing outcomes in patients with an intact stapes tend to be better than those where thestapes suprastructure is absent.

Pre-surgical knowledge of the status of the ossicular chain would allow the surgeon to better advise the patient on the degree of hearing attainable after surgery.

Labyrinthine fistula can be accurately detected most of the time when both axial and coronal images are taken to look for erosion of the semicircular canals. The most common canal affected is the lateral semicircular canal and reliance on coronal sections alone may lead to a 50% false positive rate of dehiscence due to the artifact of partial volume averaging. Even with the addition of the axial scans, minute fistulamay still be missed as seen in 1 patient. The scan in this case showed thinning of the bone over the lateral semicircular canal but no obvious fistulisation.

Careful dissection of the cholesteatoma matrix over the dome of the lateral semicircular canal revealed a tiny bony canal fistula. The surgeon is well advised to treat every case as a potential fistula until proven otherwise.

Tegmen erosion is well seen on coronal imaging, but again misinterpretations may result from volume averaging effects.Such is the case in one patient where the scan suggested the tegmen to be breached but surgically proven to be intact. The reverse is also possible whereby a dehiscent area may appear intact radiologically.

Facial canal dehiscence is a fairly common finding in 55% of temporal bones, and usually occurring in a focal area in the tympanic portion of the fallopian Canal. The problem with partial volume averaging artifact is again evident here as the fallopian canal can be so thin even in a non-pathological ear as to appear dehiscent on a CT scan. This explains for the poor radiological correlation with the surgical findings. In addition, we also found visualising the tympanic portion of the facial canal to be especially difficult when there is an adjacent pathologic soft tissue mass in the mesotympanum .Knowledge of facial nerve anatomy, careful dissection technique in the vicinityof the nerve and the use of intra-operative facial nerve monitoring all help towards reducing the likelihood of an iatrogenic facial nerve injury.

Besides giving information on the status of the middle ear structures, the CT scan can also delineate the extent and location of disease. Cholesteatoma has a tendency to reside in hidden areas such as the sinus tympani and the anterior epitympanum. Knowledge of the disease extent and information on the degree of mastoid pneumatisation aid in planning the surgical approach, e.g. whether to keep the canal wall up or down. However one should note that the scan may overestimate the extent of disease as it

often cannot distinguish definitively between cholesteatoma and granulation tissue.An enhanced MRI scan can discern the two better and may be used if clinically indicated.

Complications of cholesteatoma are associated with a high morbidity and can even be life threatening. However the surgical treatment itself is also fraught with risks to many important structures because of the complex anatomy of the temporal bone. While we cannot quantify how the pre-operative scan decrease the rate of surgical complications, it is undoubtedly helpful in teaching our surgeons in training, and enhancing their spatial orientation of the middle ear cavity.

A thorough understanding of the surgical anatomy and knowledge of normal variations are crucial when performing operations for chronically infected ears, and the pre-operative high resolution CT scan is useful in this regard. The scan aids even the experienced otologist by alerting him to the presence of anatomical variations (such as a high riding jugular bulb or a prominent sigmoid sinus), and potential surgical hazards that may arise from the destructive nature of the disease (such as a labyrinthine dehiscence).

Because this was not a blinded study, there is a possible inherent bias for the surgeon when reporting the surgical results since he would have looked at the scans before operating. The radiologist may also be biased, as he is blinded to the surgical findings but not to the clinical diagnosis of cholesteatoma. A better study may have been to compare the radio-surgical

correlation of those with and without cholesteatoma, with the radiologist blinded to the clinical diagnosis. The problem is that most patients with chronic otitis media without cholesteatoma do not require preoperative scans and so cannot be used as controls.

When diagnosis is in doubt as in attic retraction pocket HRCT is vital. Scutum erosion , extension of soft tissue into aditus or erosion of ossicle warrants surgical intervention. Only soft tissue – patient is kept on observation.

When patients wish to avoid operation as in pregnant females and only hearing ear HRCT helps in deferring surgery.

HRCT helps to inform patients of what to expect especially facial paralysis.

HRCT is equally important in diagnosis of congenital cholesteatoma and its further management.

HRCT is indispensable in revision cases in knowing the altered anatomy and extent of disease.

While a definitive diagnosis of cholesteatoma can only be made at the time of surgery, the scan picture may at times influence the decision and timing of surgical exploration.

In one patient Prem Kumar 16 Male HRCT finding of Tegmen and sigmoid plate erosion helped the surgeon to be cautious and prevent dural injury.

Badsha 35 male with postero superior marginal granulation of right ear had facial canal dehiscence in HRCT. Patient was fore warned regarding the possibility of facial paralysis and surgeon was doubly cautious while working near the tympanic portion of the facial nerve.

Janaki 41 female a case of left aural polyp had tegmen dehiscence in HRCT. Patient was counseled regarding the impending complications and advised immediate surgery.

With the use of preoperative HRCT the disease extent in hidden areas like sinus tympani, facial recess and anterior epitympanic recess is assessed and intact canal wall procedures planned in selected cases.

Two cases were operated with the Endoscope and inside out technique performed following the sac after knowing the limited extent of the disease in the scan.

Inside out atticoantrostomy was performed in pachiappan a patient with low lying dura and limited attic disease.

HRCT of Dhivya revealed sigmoid sinus dehiscence which was found to be sealed with granulation during surgery.

Pre-operative demonstration of facial nerve canal involvement was often difficult not only because of its small size but due to its oblique orientation (tympanic portion) and the presence of developmental dehiscence, particularly when abutted by the soft tissues.

Radio surgical agreement is excellent for malleus good for incus, stapes, labyrinth, and tegmen while poor for facial canal in our study.

Hence high resolution CT should be a routine examination prior to cholesteatoma surgery.

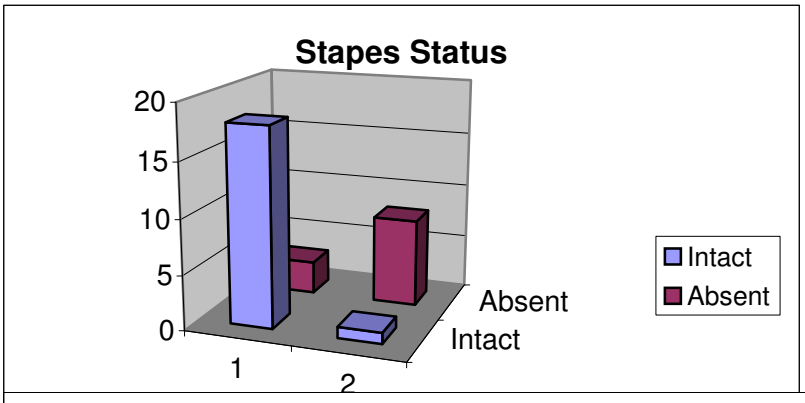
CONCLUSION

The patient is benefited as he has pre surgical assessment rather wait for results of surgical exploration. Forewarned about complications. The patient has a pictorial depiction of his disease and understands the need for surgical intervention and difficulty in hearing preservation.

The surgeon is armed with a visual aid to preoperative counseling ,spatial orientation of disease extent and identifies problem areas prior to surgery.

PREOPERATIVE HRCT IS INDISPENSABLE IN PATIENTS WITH MIDDLE EAR CHOLESTEATOMA.

18	1
3	8



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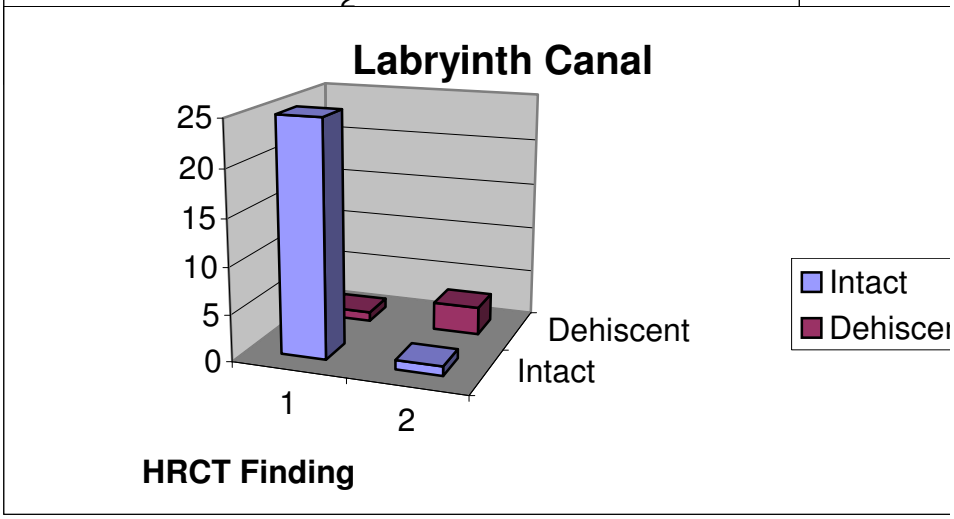

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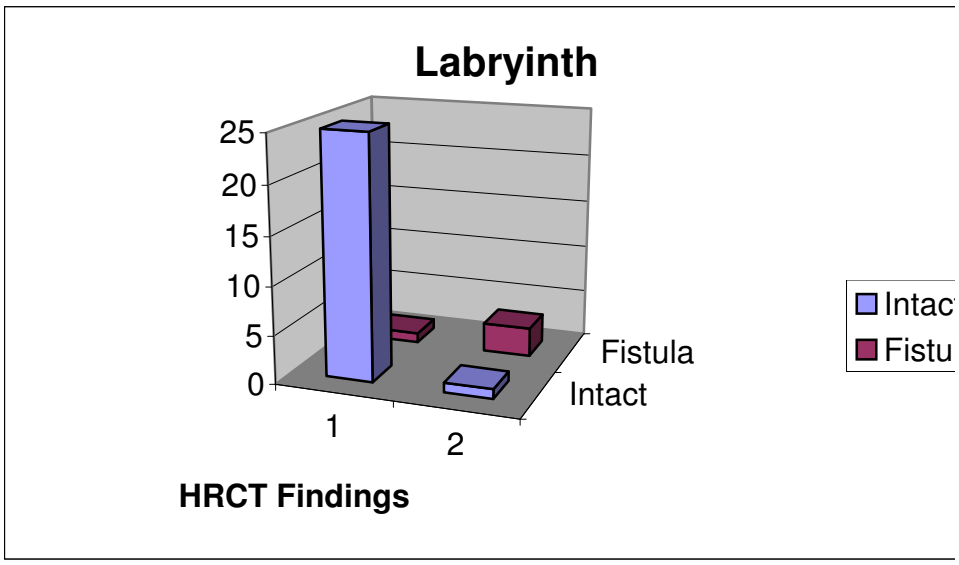

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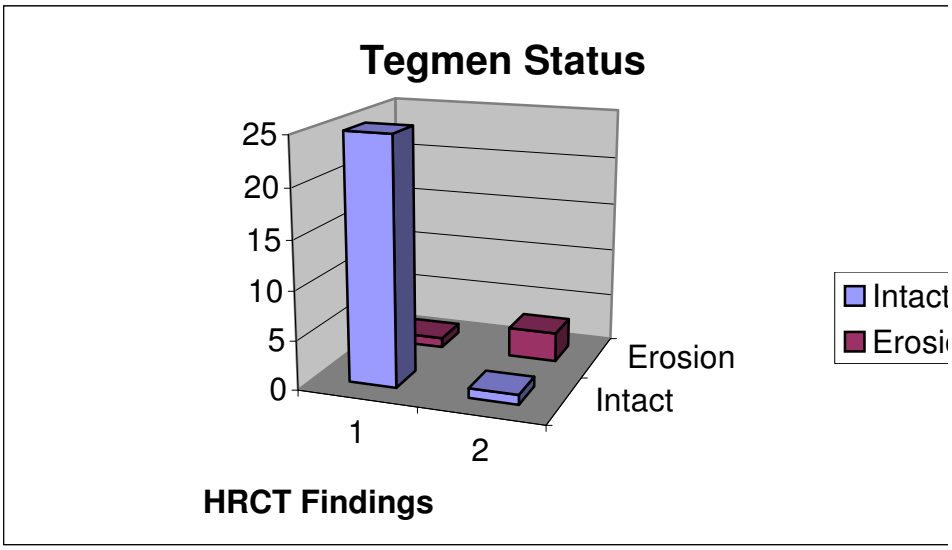
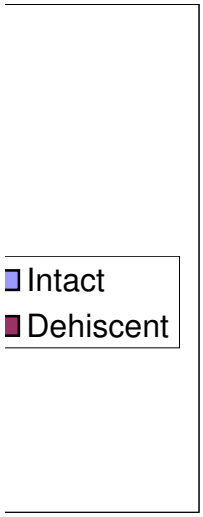

Tegmen Status
25
20
15
10
5
0
1
2
Erosion
Intact
HRCT Findings
Intact
Erosi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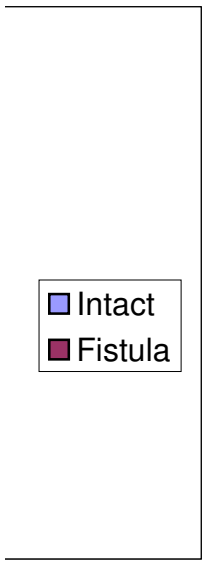
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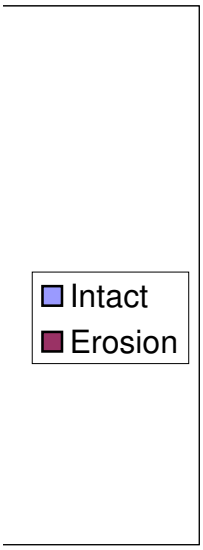
Intact
Erosion

S.NO	Name	Age	Sex	Compliants	Otoscopic findings	Audiogram findings	Surgery	CT/Surgical	Scutum erosion	Aditus widening	Ossicle displacement	Ossicle Destruction			Labryinthine Fistula	Facial canal dehiscence	Tegmen Erosion	Mastoid destruction
												M	I	S				
1	Arivudainambi	40	M	Right Ear Discharge	Postero superior marginal	MOC	MRM	CT	A	P	A	P	P	P	A	A	P	P
								Surgical	A	P	A	P	P	A	A	A	P	P
2	Gayathri	13	F	Right Ear Discharge	Attic cholesteatoma	MC	MRM	CT	A	P	P	A	P	A	A	P	P	P
								Surgical	A	P	P	A	P	P	A	P	P	P

S.NO	Name	Age	Sex	Compliants	Otoscopic findings	Audiogram findings	Surgery	CT/Surgical	Scutum erosion	Aditus widening	Ossicle displacement	Ossicle Destruction			Labryinthine Fistula	Facial canal dehiscence	Tegmen Erosion	Mastoid destruction	Other findings
												M	I	S					
1	Arivudainambi	40	M	Right Ear Discharge	PSRP with Marginal Perforation	MOC	MRM	CT	A	P	A	P	P	P	A	A	P	P	
								Surgical	A	P	A	P	P	A	A	A	P	P	
2	Gayathri	13	F	Right Ear Discharge	Attic cholesteatoma	MC	MRM	CT	A	P	P	A	P	A	A	P	P	P	
								Surgical	A	P	P	A	P	P	A	P	P	P	
3	Shanthi	28	F	Right Ear Discharge	Scutum erosion, Attic Perforation with Granulation	SC	MRM	CT	A	P	A	P	P	A	A	A	A	P	
								Surgical	A	P	A	P	P	A	A	P	A	P	
4	Prakash	23	M	Right Ear Discharge	Attic perforation with cholesteatoma	MC	MRM	CT	P	P	A	P	P	A	A	A	P	P	
								Surgical	P	P	A	P	P	A	A	A	P	P	
5	Mariappan	50	M	Left Ear Discharge	PSRP with Cholesteatoma	MM	MRM	CT	P	P	P	A	P	A	A	A	A	P	
								Surgical	P	P	P	A	P	A	A	P	A	P	
6	Kalyani	32	F	Right Ear Discharge	PSRP with Cholesteatoma	MC	MRM	CT	A	P	A	A	P	A	A	A	A	P	
								Surgical	A	P	A	A	P	A	A	A	A	P	
7	Muniyammal	40	F	Left Ear hard of hearing Blood stained discharge	PSRP with Granulation	MOC	MRM	CT	P	P	A	A	P	P	A	A	A	P	
								Surgical	P	P	A	A	P	P	A	A	A	P	
8	Bhavani	28	F	Right Ear Discharge vertigo	PSRP with Marginal Perforation	MC	MRM	CT	A	P	A	A	P	A	P	P	A	A	
								Surgical	A	P	A	A	P	A	P	A	A	A	
9	Janaki	41	F	Left Ear Discharge hard of hearing	Aural polyp obstructing view of parsflaccida	MOC	MRM	CT	P	P	A	P	P	P	A	A	A	A	
								Surgical	P	P	A	P	P	P	A	A	P	A	

S.NO	Name	Age	Sex	Compliants	Otoscopic findings	Audiogram findings	Surgery	CT/Surgical	Scutum erosion	Aditus widening	Ossicle displacement	Ossicle Destruction			Labryinthine Fistula	Facial canal dehiscence	Tegmen Erosion	Mastoid destruction	Other findings
												M	I	S					
10	Venkatesh	28	M	Both ears discharge hard of hearing	Right Aural polyp , Left Attic perforation	SC	MRM	CT	P	A	A	P	P	P	A	A	A	P	CWE
								Surgical	P	P	A	P	P	P	A	P	A	P	
11	Badshah	35	M	Right ear discharge hard of hearing	PSRP with Cholesteatoma	MC	MRM	CT	P	P	A	P	P	A	A	P	A	P	
								Surgical	P	P	A	P	P	P	A	P	A	P	
12	Leelavathi	35	F	Right ear discharge Headache	Attic perforation with cholesteatoma	MOC	MRM	CT	P	A	A	P	P	P	A	A	A	P	
								Surgical	P	A	A	P	P	P	A	P	A	P	
13	Kudiarasu	27	M	Left ear discharge	Scutum erosion with attic cholesteatoma	SC	MRM	CT	P	P	P	P	A	A	A	A	A	P	
								Surgical	P	P	P	P	P	P	A	A	A	P	
14	Jayamani	25	F	Both ears discharge hard of hearing	Right Postero superior retraction pocket with cholesteatoma	MC	MRM	CT	P	A	P	A	A	A	A	A	A	P	
								Surgical	P	A	P	A	P	A	A	A	A	P	
15	Deepa	18	F	Both ears discharge hard of hearing	PSRP with Cholesteatoma	MOC	MRM	CT	A	P	A	A	A	A	A	A	A	P	
								Surgical	P	P	A	A	P	A	A	A	A	P	
16	Minalkodi	30	F	Right ear discharge hard of hearing	Right Attic cholesteatoma with aural polyp	MOC	MRM	CT	A	P	P	A	P	A	A	A	A	P	CWE
								Surgical	A	P	P	A	P	A	A	A	A	P	

S.NO	Name	Age	Sex	Compliants	Otoscopic findings	Audiogram findings	Surgery	CT/Surgical	Scutum erosion	Aditus widening	Ossicle displacement	Ossicle Destruction			Labryinthine Fistula	Facial canal dehiscence	Tegmen Erosion	Mastoid destruction	Other findings
												M	I	S					
17	Revathi	16	F	Left Ear Discharge hard of hearing	Left Attic perforation with cholesteatoma	MOC	MRM	CT	P	P	P	P	A	A	A	A	A	A	
								Surgical	P	P	P	P	P	A	A	A	A	A	
18	Rathnam	33	M	Left ear discharge	Left Attic cholesteatoma	MM	MRM	CT	A	P	A	A	P	P	A	P	A	P	
								Surgical	A	P	A	P	P	P	A	A	A	P	
19	Rajeshwari	40	F	Right Ear Discharge vertigo	PSRP with Granulation	MOM	MRM	CT	P	A	A	P	P	P	A	A	A	P	
								Surgical	P	P	A	P	P	P	P	P	A	P	
20	Sarasu	33	F	Both ears discharge hard of hearing tinnitus	PSRP with Granulation	MOC	MRM	CT	P	P	A	P	P	P	A	A	A	A	
								Surgical	P	P	A	P	P	P	A	A	A	A	
21	Punkaj	16	M	Right ear discharge hard of hearing	Right Attic cholesteatoma	MOM	MRM	CT	A	P	A	A	P	P	A	A	A	P	
								Surgical	A	P	A	A	P	P	A	A	A	P	
22	Premkumar	16	M	Right ear discharge hard of hearing	Right Attic cholesteatoma	SC	MRM	CT	P	P	A	A	P	P	P	A	P	P	
								Surgical	P	P	A	P	P	A	P	A	A	P	

S.NO	Name	Age	Sex	Compliants	Otoscopic findings	Audiogram findings	Surgery	CT/Surgical	Scutum erosion	Aditus widening	Ossicle displacement	Ossicle Destruction			Labryinthine Fistula	Facial canal dehiscence	Tegmen Erosion	Mastoid destruction	Other findings
												M	I	S					
23	Saravavan	20	M	Left ear discharge vertigo	PSRP	MC	MRM	CT	A	P	A	P	P	P	P	P	A	P	
								Surgical	A	P	A	P	P	P	P	P	A	P	
24	Bhoopathy	18	M	Right Ear Discharge vertigo	PSRP	MC	MRM	CT	P	P	P	A	P	P	A	A	A	P	
								Surgical	A	P	P	A	P	P	A	A	A	P	
25	Saranya	18	F	Left ear discharge	PSRP	MC	MRM	CT	P	A	A	P	P	A	A	A	A	P	
								Surgical	P	A	A	P	P	A	A	A	A	P	
26	Dhivya	12	F	Right ear discharge	Right Attic cholesteatoma	MOC	MRM	CT	P	P	A	A	P	P	P	A	A	P	SPE
								Surgical	P	P	A	A	P	P	A	A	A	P	
27	Shekar	28	M	Right Ear Discharge vertigo	PSRP	MOM	MRM	CT	P	A	A	A	P	P	A	A	A	P	
								Surgical	P	A	A	A	P	P	A	A	A	P	
28	Priya	18	F	Right ear discharge	PSRP	MOC	MRM	CT	A	P	P	A	A	A	A	A	A	P	
								Surgical	A	P	P	A	P	A	A	A	A	P	
29	Pachiappan	15	M	Left ear discharge	PSRP	MOC	IOT	CT	A	P	P	A	A	A	A	A	A	A	LLD
								Surgical	A	P	P	A	A	A	A	A	A	A	
30	Pitchandi	9	M	Left ear discharge	Left Attic cholesteatoma	MC	IOT	CT	P	A	A	A	P	P	A	A	A	A	
								Surgical	P	A	A	A	P	P	A	A	A	A	

Abbreviation	
A	Absent
P	Present
MC	Mild Conductive Hearing Loss
MOC	Moderate Conductive Hearing Loss
SC	Severe Conductive Hearing Loss
MOM	Moderate Mixed Hearing Loss
MM	Mild Mixed Hearing Loss
IOT	Inside Out Mastoidectomy
MRM	Modifed Radical Mastoidectomy
LLD	Low Lying Dura
SPE	Sinus Plate Erosion
CWE	Canal Wall Erosion
PSRP	Postero Superior Retraction Pocket

HRCT TEMPORAL BONE IN CHOLESTEATOMA PATIENTS

PROFORMA

Patient name ;

Age/sex

Complaints;

Otoscopic findings;

Audiogram

HRCT FINDINGS;

PER-OPERATIVE FINDINGS;

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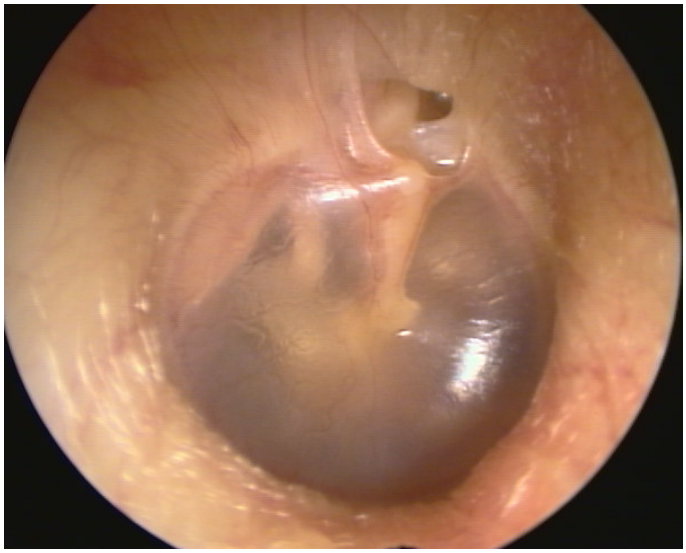
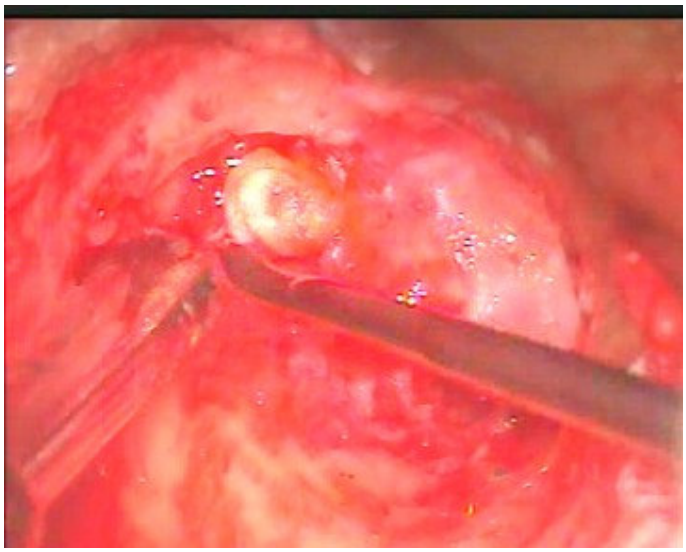
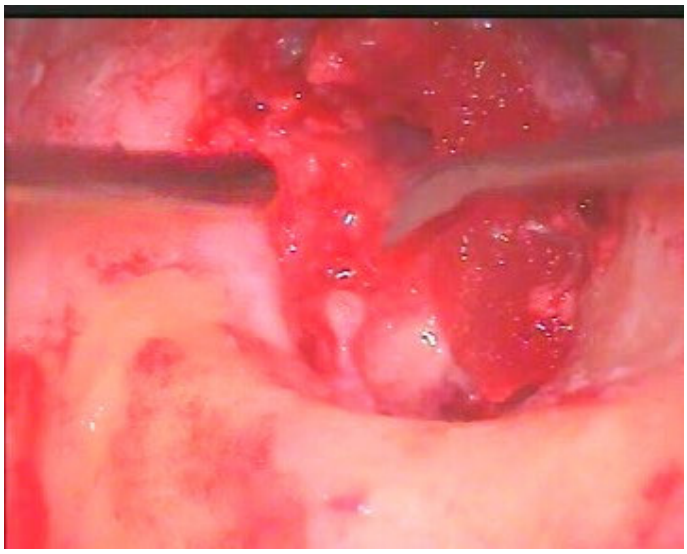
SCUTUM EROSION



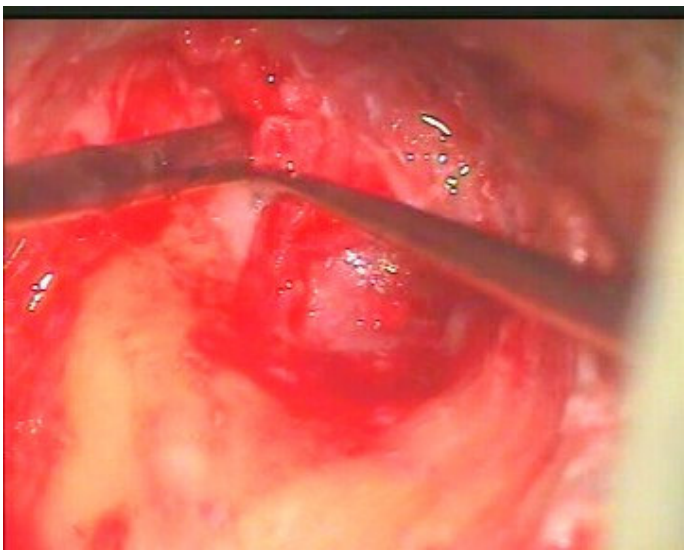
HEAD OF MALLEUS DURING INSIDE OUT MASTOIDECTOMY



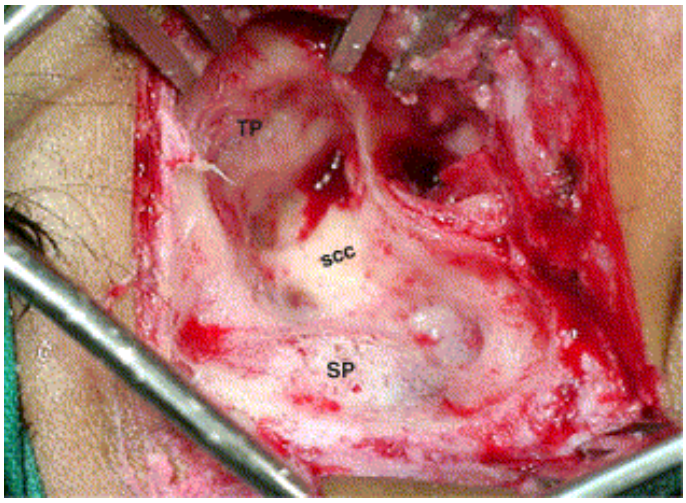
DISSECTION OF CHOLESTEATOMA SAC OVER SUPRA STRUCTURE OF STAPES



DISSECTION OF CHOLESTEATOMA SAC



PEROPERATIVE PICTURE OF MASTOIDECTOMY



HISTOPATHOLOGICAL APPEARANCE OF CHOLESTEATOMA

ATTIC CHOLESTEATOMA

POSTEROSUPERIOR RETRACTION POCKET WITH CHOLESTEATOMA

CT AXIAL ANATOMY

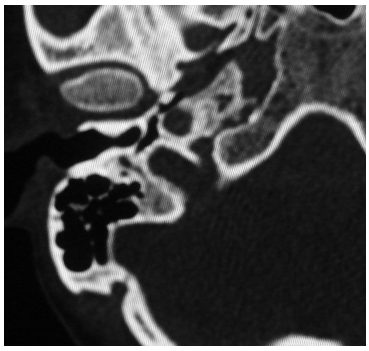
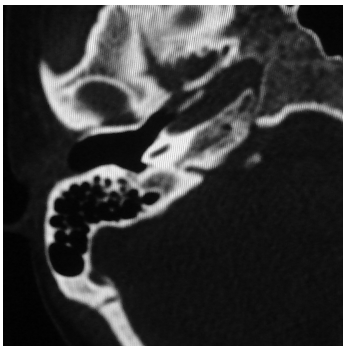


FIG 1



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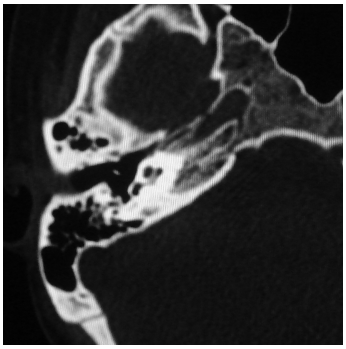

FIG 3

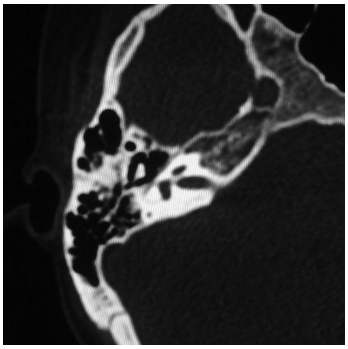

FIG 4

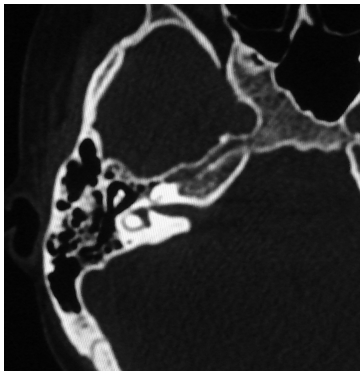

FIG 5

CT CORONAL ANATOMY

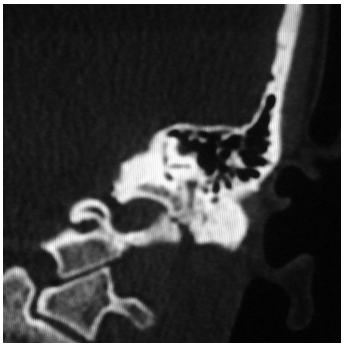

FIG 6

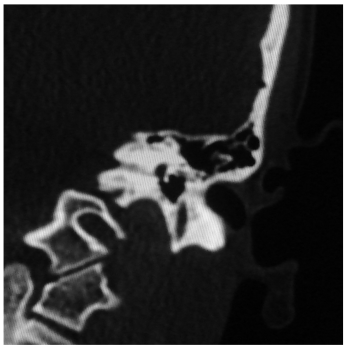

FIG 7

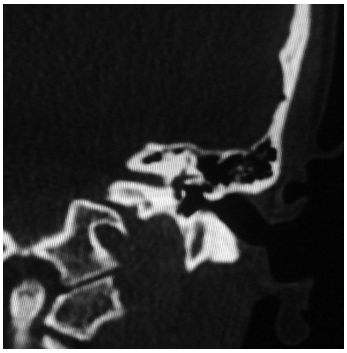

FIG 8

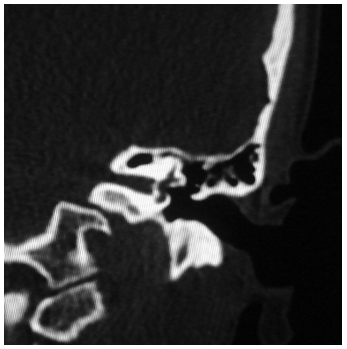

FIG 9

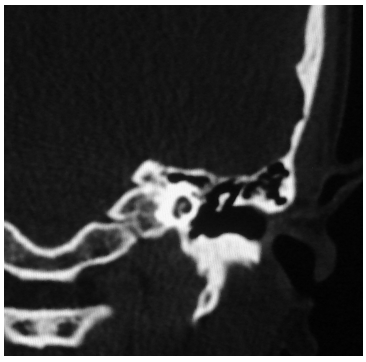

FIG 10