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ENDOSCOPIC TYPMPANOMASTOID EXPLORATION

[FUNCTIONAL ENDOSCOPIC EAR SURGERY-FEES]

Sanjay Kumar K[1] Muthukumar R[2] Balasubramanian T[3]

Kilpauk Medical College[1] Madras Medical College[2] Stanley Medical College[3]

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Abstract:

Tympano mastoidectomy is usually performed using operating microscope. This study reports a case series of tympanomastoidectomy which was performed using an endoscope.

Endoscopic Tympanomastoidectomy for atticoantral type of CSOM is an excellent technique for complete removal of cholesteatoma especially from inaccessible areas of middle ear cleft including facial recess, sinustympani

Transmeatal removal of disease from mastoid antrum and even tip cells is possible with endoscopes.

Preservation of as much of normal mucosa of the middle ear cleft is possible with this technique, which promotes early reaeration of the mastoid cavity leading to better hearing outcome.

Soft wall reconstruction has distinctive advantage of short additional time for reconstruction procedures, restoration of self cleaning EAC, early post operative epithelisation of tympanic membrane and the EAC.

Limitation of endoscopic technique: The endoscopic technique of tympanomastoidectomy with softwall reconstruction is not possible in cases   with large mastoid cavity and in ears where a thin lateral rim of bony meatal wall (that can support soft wall) is retained, because of extensive disease.

Like Functional Endoscopic sinus surgery (FESS) for nose, Endoscopes have changed the treatment concept of atticoantral disease, with complete removal of the disease and preservation of normal mucosa, that restores the normal physiology of middle ear cleft. This has led to the development of new concept of Functional Endoscopic Ear Surgery (FEES) for atticoantral type of CSOM.

INTRODUCTION

Chronic Supportive Otitis Media (CSOM), infection of the middle ear cleft has been recognized since prehistoric times. It is characterized by intermittent or persistent mucoid, mucopurulent or purulent discharge through a perforated tympanic membrane and the Attico antral (unsafe) variety associated with cholesteatoma. Cholesteatoma often runs a malignant course impairing patient's hearing and involving the surrounding structures including brain, thereby increasing the morbidity and mortality of those affected.

Although, the introduction of sulpha drugs by Domegk in 1935 and penicillin by Sir Alexander Fleming in 1942 reduced the mortality in case of safe type of CSOM, they could not cure cholesteatoma. Surgery was thought of as a treatment for cholesteatoma as early as in the eighteenth century. Before the advent of operating microscope the aim of cholesteatoma surgery was to convert the unsafe ear into safe ear. Thus the focus of attention was on clearance of disease from the mastoid and allowing any residual disease of the mastoid to be drained externally via the meatoplasty. Hence the chance for incidence of microscopic residual disease in the middle ear and mastoid was very high.

With the advent of operating microscope the eradication of disease from the tympanum and mastoid cavity was complete. Hence it was possible to achieve a dry ear in addition to converting the unsafe ear to safe ear. With further improvements in operating skill (technique) middle ear ossicular chain reconstruction was made possible and improvement of hearing was also additionally achieved (safe ear, dry ear, hearing ear). However with the conventional canal wall down procedures, residual hearing loss and non-functioning mastoid cavity problems like accumulation of excessive debris, wax and infection of the skin lined mastoid cavity was encountered. To overcome these problems the canal wall up procedures like CAT (combined approach tympanoplasty) was introduced. However two main disadvantages were fraught with the CAT procedure . They were non-functioning mastoid antrum devoid of lining respiratory mucosa and residual hidden cholesteatoma.

To strike a balance between these two situations, a conventional modified radical mastoidectomy done by inside out technique was introduced which limits the size of the non-functioning mastoid cavity. In this procedure cholesteatoma was traced from its origin and the bone drilling stopped as we reach the fundus of the sac. This was possible in a sclerotic mastoid and the cavity problem was very less due to small size of the mastoid cavity even though it was non-functional.

Further research and experiments of Sade and Takahashi has led to the concept of preservation of much of the attic and mastoid mucosa at the same time achieving complete exenteration of cholesteatoma . It entails removal of the posterior bony meatal wall which was then reconstructed with soft tissue. This soft wall reconstruction of the posterior meatal wall did not retract because of the transmucosal gas exchange function of the retained mucosa (functioning mastoid). In this operative technique Takahashi used operating microscope.

Our study goes one step further by using nasal endoscope transmeatally . This offers the advantage of higher magnification, precise localization of the disease, visualization of inaccessible areas (not possible with microscopes) with light delivery closer to the area of interest. As with Takahashi technique the cholesteatoma is traced from its origin, followed up to the fundus of the sac. This technique allows less bone removal (due to wide angle of vision) , preservation of more normal mastoid mucosa and hence better mastoid aeration with lifting of reconstructed soft wall and restoration of normal physiology of middle ear cleft in terms of hearing. Thus this study on endoscopes in otology will help in better understanding of the anatomy, physiology, disease pathology and surgical procedures involved in cholesteatoma .

AIM AND OBJECTIVES OF THE STUDY

1. To study endoscopic tympanomastoid exploration and its outcome in atticoantral type of chronic suppurative otitis media.
2. The usefulness of the endoscopes in clearing the disease from the inaccessible sites of the middle ear cleft.
3. Role of endoscopes in the success of soft wall reconstruction in canal wall down procedure.

MUCOUS MEMBRANE OF MIDDLE EAR CLEFT

The lining of the middle ear spaces is the extension and modification of the respiratory mucous membrane that lines the nasal cavity, nasopharynx and Eustachian tube. In all these regions the mucous membrane consists of a layer of ciliated columnar cells with a subepithelial layer of connective tissue. A film of mucous clothes the membrane and is replenished by strategically located goblet cells and mucous glands. The mucous film is kept in constant motion by the continuous action of cilia, the direction of movement of the cilia being from the tympanic cavity into the nasopharynx.

A thin delicate mucous membrane lines the whole of middle ear cavity and is reflected onto the ossicles and tendons. It is continuous with the mucous membrane of the mastoid antrum and Eustachian tube. The mucous membrane consist of non – ciliated cuboidal epithelium which is arranged in two to three cell layers but without a basement membrane and becomes ciliated columnar type especially near the opening of Eustachian tube and hypotympanum. The epithelium changes to flat pavement epithelium in the attic and mastoid air cells.

As one progresses from the cartilaginous portion of eustachian tube to its bony and from the tympanum to the antrum and mastoid air cells, the sub epithelial connective tissue becomes thinner until the pavement epithelium and the periosteum together form a thin delicate membrane. The property to produce mucous is largely lost in the pavement epithelium.

MUCOSAL SPACES OF THE MIDDLE EAR

The mucous membrane is thrown into a series of folds by the intratympanic structure dividing the middle ear into mucosal spaces of surgical importance. The ossicular chain, ligaments, tendons of tensor tympanic and stapedius muscles and the chorda tympani nerve are called the 'viscera' of the middle ear and the mucosal folds are the mesenteries.

The attic is almost completely separated from the mesotympanum by the ossicles and their folds except for two small but constant opening called isthmus tympani anticus and isthmus tymani posticus.

The transversely placed superior malleolar fold divides the attic into a small anterior malleolar space which lies above the tensor tympani fold that may prevent cholesteatoma from the attic reaching the anterior mesotympanum and a larger posterior compartment. The posterior compartment is further subdivided by the superior incudal fold into a superior incudal space (lateral to the fold) and a medical incudal space. The entrance into the prussak's space is usually located between the lateral malleolar fold and lateral incudal fold. This latter fold may arrest the passage of cholesteatoma, through a posterior superior marginal perforation, into the attic.

The interior incudal space

It is limited superiorly by the lateral incudal fold, medially by the medial incudal fold, laterally by the posterior malleolar fold and anteriorly by the interosseous fold, which lies between the long process of incus and upper two thirds of the handle of malleus.

The anterior pouch of von Troeltsch

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

The posterior pouch of Von Troeltsch

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

Prussack's space

It is small spacelying between the neck of malleus medially and the pars flaccida laterally. It is bounded below by the short process of malleus and above by the fibres of lateral malleolar fold, which fan from the neck of malleus to be inserted along the entire rim of the notch of Rivinus. A cholesteatoma may extend from Prussack's space, under lateral incudal fold, into the posterior mesotympanum.

The mucosal folds may limit the infection to one or several of the compartment in the middle ear and if the disease is thus limited it may be possible to control it in the affected compartment while it may be possible to control it the affected compartment while preserving the integrity and fuction of the adjacent structures.

From the prussack's space cholesteatoma may spread in three directions.

Posterior route

This is the commonest route. The extension would be into the superior incudal space lateral to the body of incus which lies in the posterolateral portion of the attic. From here it penetrates the aditus and gains access to the mastoid.

Inferior route

This occurs frequently into the inferior incudal space or posterior pouch of Von Troeltsch into the posterior mesotympanum. Cholesteatoma may then spreads to the region of stapes, round window, sinus tympani and facial recess.

Anterior route

It is less common. Penetration anterior to the malleus head leads to involvement of the anterior epitympanum and supratubal recess. Downward growth into the anterior mesotympanusm may occur via the anterior pouch of Von Troeltsch.

Connection between middle ear and mastoid

A series of mucosal folds and suspensory ligaments, known as the tympanic diaphragm, nearly seprates the mesotympanum from the epitympanum and mastoid. The major components of this partition are the malleus head and incus body, lateral and medial incudal folds, anterior and lateral malleolar folds, and the tensor tympani fold. Only two narrow passages anterior and posterior tympani isthmus breach this diaphragm. The anterior tympanic isthmus is larger, lies medial to the body of the incus and passes between the stapes and the tensor tympani tendon. The posterior isthmus is small and lies between the medial incudal fold and posterior tympanic wall. The epitympanum is connected to the mastoid antrum by a small triangular bony passage known as aditus ad antrum.

The clinical importance of this tympanic diaphragm is that it resist the spread of epitympanic cholesteatoma to the mesotympanum and vice versa. Also, the patency of the aditus and antrum and tympanic isthmus is important for aeration of the mastoid. **Pneumatization of Mastoid**

Theories of mastoid pneumatisation

1. Bast and Anson proposed endodermal invasion theory

2. Schwarbart pioneered the theory of mesodermal invasion of potential space formation in the bone marrow with breakdown of parting walls.

3. Mastoid plate destruction by the pull of sternocleidomastoid inner and outer plates of mastoid separates and air enters in between.

Theories of failure of pneumatisation of mastoid:

1. Albrecht (1930) stated that infected meconium in the middle ear due to birth injury or suffocation may be the reason for pneumatisation failure.

2. Wittmaack (1931) believed that deficient pneumatization resulted from infantile otitis media which interfered with normal absorption of diploe.

3. Diamante (1954) found on X-ray examination, 20% of normal individuals had Cellular mastoids. He felt pneumatization was determined by hereditary factors.

4. Tumarkin (1961) believed Eustachian tube obstruction with negative middle ear pressure was the cause of failure of aeration of the middle ear cleft.

5. Ruedi (1963) stated that a necrotizing otitis media in infancy later arrested pneumatization. He felt sclerosis is the result of infection and not the cause. If pneumatization fails, the bone remains diploic or it may develop into compact bone by the physiologic process of cancellous bone formation in marrow spaces. On the other hand, infection occurring in the

pneumatized, diploic or compact bone produces sclerosis as a response to infection. Sclerotic bone can be grossly distinguished from compact bone by the presence of thick bony septa with absent marrow spaces. Tos later classified Cholesteatoma on the basis of the site of origin of Cholesteatoma, which is an important factor for surgical procedure and prognosis.

Attic Cholesteatoma – Defined as retraction of pars flaccida or Shrapnel's membrane extending into attic or aditus and eventually into the mastoid antrum, or entire tympanic cavity.

Sinus Cholesteatoma – Posterosuperior retraction or perforation of the pass tensa extending to the tympanic sinus, posterior tympanum and beyond.

Tensa Cholesteatoma - Retraction and adhesion of the entire pars tensa involving the tympanic orifice of the Eustachian tube (may also extend further into the attic).

In 1986, Meyerhoff and Truelson attempted to classify Cholesteatoma according to its pathophysiology, location, Eustachian tube function, ossicular defects and presence or absence of complications. They divided the lesions into,

• **Primary acquired-** A primary acquired cholesteatoma is associated with a defect in the pars flaccida such that retraction pocket forms, which is unable to clean itself. It does not develop from a perforation but perforation may develop in the tympanic membrane after cholesteatoma formation. While middle ear and Eustachian tube pathology may exist, but is not the rule

• **Secondary acquired-** A secondary acquired cholesteatoma arises from in growth of epithelium through a perforation of the pars tensa or from a pars tensa retraction pocket and through marginal perforations; these cholesteatomas invade the middle ear and mastoid and frequently involve ossicular chain. Central perforation can be involved as well. And persistent middle ear infection and Eustachian tube dysfunction are the rule.

• **Tertiary acquired-** Tertiary cholesteatoma is that which is acquired and exists behind a normal appearing tympanic membrane, which may result from a single chronic inflammatory event of the middle ear (Ruedi, 1959) or it may occur as a result of a penetrating or implosive injury to the tympanic membrane implanting squamous epithelium into the middle ear. Chronic infection and Eustachian tube dysfunction are exception in this type of cholesteatoma.

MATERIALS AND METHODS

Study design	:	Prospective Study
Study place	:	Department of ENT Stanley Medical College.
Study period	:	September 2008- August 2009
Follow up period	:	September 2009- August 2010.
Sample size	:	35 patients

Inclusion criteria:

Patients attending ENT OPD at Govt. Stanley Medical College with

- Age 11-60 yrs
- Sex: both Male and Female.
- Chronic Suppurative Otitis Media with Cholesteatoma.
- Unilateral or Bilateral disease.

Exclusion criteria:

- Revision Mastoid surgeries.
- Patient with intracranial complications of Csom
- Patients with external and middle ear abnormalities (congenital or acquired).
- Medically and surgically unfit patients.

Materials:

In this study the procedure adopted is endoscopic tympanomastoid exploration. The equipment consist of :

1. 4mm – wide angled zero degree Hopkin endoscopes used for nasal surgery.
2. Video equipment consists of single chip STORZ camera.
3. Routine middle ear microsurgical instruments such as curette, rosens, plester, pick, etc.., were used.
4. CCTV monitor placed opposite the surgeon and positioned across the patients head.

Methodology:

The selected patients were subjected to detailed history taking and clinical examinations. Complete examination of the ear done. Nose paranasal sinuses pharynx and larynx were examined to rule out any septic foci. Systemic diseases unrelated to ear were ruled out. Otoendoscopy and audiometric tests were performed.

The selected cases were then made to undergo appropriate investigations. Routine blood investigations like hemoglobin percentage, total and differential leucocyte count, bleeding and clotting time and routine urine investigations were done for all cases.

X-ray bilateral mastoid (law's view) was taken for all cases. Puretone audiometry was done in a sound proof room using Maico ma 52 clinical diagnostic two channel audiometer.

Informed consent was obtained from each patient after counseling them and their relatives regarding the nature of the disease and surgery. Outcome of the surgery and all possible complications were explained to them.

All of them were admitted to the hospital one day prior to the surgery. All of them underwent Endoscopic Tympanomastoid exploration surgery. Eleven patients were operated under General anesthesia and the rest twenty four under Local anesthesia. Temporalis fascia was the graft material taken in all cases. Reconstruction of hearing mechanism was undertaken in all cases whenever possible.

Following surgery the external auditory canal was filled with gelfoam and mastoid compression bandage was applied, which was replaced on the second day and finally taken off on the seventh postoperative day when the sutures were removed from the graft harvested site.

Postoperative intravenous antibiotics were given for one week when the patients were in the hospital and oral antibiotics continued for another two weeks.

All patients were followed up weekly for one month, fortnightly for three months and then once in two or three months till the end of the study. Postoperative Puretone audiometry was done at three months and was documented. During every follow up, cases were evaluated for persistence of discharge, collection of debris and wax, take up of the graft and any other complications which the patients experienced.

Operative Technique

Anesthesia

Endoscopic tympanomastoid exploration can be done under local or general anesthesia. Both have their own merits and demerits.

Advantages of General Anesthesia

• Airway is better controlled

• More comfortable to the patient

• Useful in pediatric age group and in apprehensive patients.

Advantages of Local Anesthesia

• Allows hearing as well as facial nerve motor functions to be tested on the operating table.

• Less bleeding and better field of surgery.

• Early ambulation.

• Less cost.

Technique of Local Anesthesia

All cases to be done under local anesthesia are best sedated by using injection fortwin (30mg) and injection Promethazine (25mg) given intramuscularly. Injection atropine 0.6mg may be added. Pulse and oxygen saturation should be monitored during the injection of local anesthetic agent and throughout the operation. Local anesthetic consisting of 2% lignocaine with 1 in 2,00,000 adrenaline is used for infiltration.

Under endoscopic visualization infiltration of local anesthetic agent given in the external meatus superiorly at the 12^{o} clock position, anteriorly at the 3^{o}’ clock position, inferiorly at the 6^{o} clock position and posteriorly at the 9^{o} clock position, when given properly the canal skin blanches , the injection come out through the perforation sometimes even lifts the cholesteatoma itself. The lumen of the needle points towards the bone and the anesthetic is injected subperiosteally.

CONCEPT AND EXECUTION OF FUNCTIONAL ENDOSCOPIC EAR SURGERY (FEES):

Surgery starts from where the disease arises, follow it as it extends posteriorly, limit dissection just where the disease ends. Apply the principles of FESS to ear surgery that is to preserve much of the normal mucosa whenever possible.

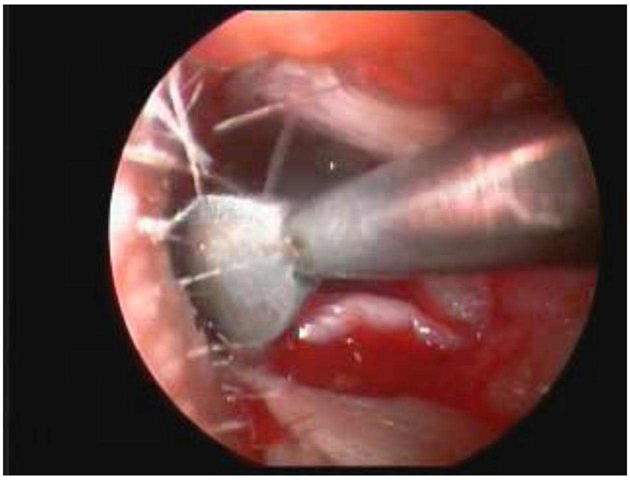
Eustachian tube is responsible for accommodating sudden changes in middle ear pressure. The middle ear pressure buffer is mastoid air cell system . Through its transmucosal gas exchange function helps in maintaining the middle ear pressure (TAKAHASHI).

PROCEDURE:

- Targeted injection with local is given in all four quadrants of ear canal.
- An endomeatal incision is made very far lateral in the postero superior quadrant extending down to 2 o clock positions in the right ear superiorly and at 11 o clock position in the left ear superiorly to 6 o clock position inferiorly.
- Tympano meatal flap is elevated down up to the annulus all around. It is elevated from sulcus near the hypotympanum, status of the middle ear mucosa checked. The area near the IS joint is visualized first; if the access is limited then Otoscerotic drilling is done. This uncovers the facial recess and sinus tympani.
- Malleus is skeletonized.
- Atticotomy is done with House curette.
- Anterior epitympanic recess if involved is visualized and curettage done.
- Always stay lateral to the cholesteatoma, do not enter the sac.
- Drilling is done lateral to the sac.
- Follow the cholesteatoma as it extends posteriorly.
- If difficulty is encountered in curetting use 2/3 mm short shaft burr with low speed.
- Intermittent irrigation is done or an assistant holding the suction tip in the in the ear canal can assist viewing the monitor (one hole 3 hand surgery) effectively making simultaneous irrigation while drilling. This is very useful for clearing the blood, enhancing the visibility during surgery.

Attic Cholesteatoma

Transcanal Incision



- Protection of middle ear (from debris and bone dust) and meatal orifice (while drilling) to prevent circumferential stenosis, must be ensured.
- Atticotomy is followed by the antrostomy as required by the extent ,this is known as " TURNING THE CORNER"
- Need for use of angled scopes is not essential except when the disease extends up to the mastoid tip or deep into facial recess and sinus tympani.
- Follow posteriorly to sinodural angle and down up to tip cells.
- Never stop till you see the back of cholesteatoma sac.
- Once the sac is seen completely dissect from posterior to anterior till Horizontal semi circular canal and look for any fistula.
- Dissect, elevate and remove the sac completely.
- Do not worry if choleateatoma comes in piece meal but always ensure complete removal.
- Thorough washing with saline is needed to remove bone dust and epithelial debris.
- Harvest temporalis fascia graft. if it is a sinus cholesteatoma or pars tensa retraction harvest cymba concha or tragal cartilage composite graft.

Cholesteatoma in the Attic

Atticotomy

- Uninvolved / edematous / polypoidal attic antral and tip cell mucosa left untouched. Upon recovery these air cells help in transmucosal gas exchange.
- For effective ventilation and drainage purpose preservation of medial attic wall mucosa, aditus mucosa and a at least a streak of mucosa from the mastoid antrum to tip is essential. Preservation of entire healthy mastoid mucosa is desirable.
- Now grafting is proceeded with. First the temporalis fascia graft tailored according to the tympanic and mastoid / canal defect and rehydrate. Place it underneath the tympanomeatal flap and reflect it along the anterior canal wall as a single unit.
- This is followed by middle ear augmentation if any (in case of pars tensa retraction /sinus cholesteatoma) using composite cartilage graft.
- Ossiculoplasty with auto incus / malleus head is done, supported by bits of gelfoam around the ossiculoplasty.
- The Tympanomeatal flap along with the temporalis graft repositioned back covering any defect of the posterior meatal wall taking care to tuck edges of the graft underneath the lateral meatal shin resting in the lateral bony rim of the mastoid cavity. After proper tucking of the facial graft the reconstructed soft wall gets lifted up.

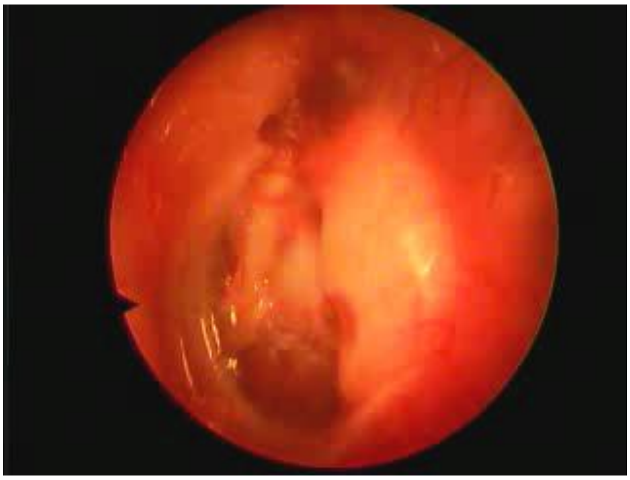
Necrosed Incus Bone

Atticoantrostomy

- Strategic placement of gel foam is now accomplished , this is very important step to secure the graft in position.
- Finally bits of gelfoam are used for scaffolding the tympanomeatal flap.
- An airtight seal in the tympanomastoid cavity is attained, temporalis fascia graft along with the tympanomastoid flap bulges laterally by the air bubble of the middle ear cleft.
- No extra packing or plugging of the meatus is needed.
- Routine mastoid dressing and post operative care given.
- FEES patients have earlier recovery.

Cholesteatoma Cleared from Matoid Tip Cells

Cartilage Graft and Softwall Postop picture



REVIEW OF LITERATURE

1) HISTORICAL REVIEW OF CHOLESTEATOMA

Existence of chronic suppurative otitis media has been documented since prehistoric times. The potential seriousness of suppurative middle ear diseases was appreciated by Hippocrates. Curveilihier used the term ‘pearly tumors’ for cholesteatoma. Cholesteatoma was described in detail by Virchow in 1854.

Chronic suppurative otitis media can be classified into, tubotympanic and an atticoantral disease; the later most commonly involves the pars flaccida and is characterized by the formation of a retraction pocket in which keratin accumulates to produces cholesteatoma. Though attic cholesteatoma is the commonest, Sinus and tensa cholesteatoma is also common. The cholesteatoma may vary in size from a small sac confined to the attic or to the posterosuperior quadrant of mesotympanum to widespread disease involving the entire mastoid bowel and the posterior half of the mesotympanum. In atticoantral disease the discharge is generally scanty, foul smelling and tends to be more chronic. When there is formation of granulation tissue or an aural polyp, blood – stained discharge may occur.

In addition to specific pathology mentioned above, various non- specific pathology may be present in chronic suppurative otitis media such as tympanosclerosis, ossicular erosion, fibrous sclerosis, mastoid sclerosis, cholesterol granuloma, labyrinthitis and sensorineural hearing loss. Ossicular erosion is a very common pathology of atticoantral disease. Cholesteatoma destroys bone by various mechanisms by releasing proteolytic enzymes, due to inflammation or due to pressure necrosis. With the invention of immunohistochemical tests recently various cytokines also have been assumed to be involved in bone destruction mechanism.

Proctor (1964) has reported that in chronic inflammation of the middle ear cleft granulation found more frequently around ossicular chain than anywhere else in the middle ear left.

Similarly, Charles D. Bluestone et al. (1990) mentioned that erosion of bone can occur anywhere in the temporal bone although the ossicles are commonly involved.

But according to Thomson et al. (1974) the erosion of the ossicular chain is due to hyperemia associated with mucosal inflammation rather than due to ischemia. The long process of incus and stapes suprastructure is the parts of the chain which are most frequently affected.

Schuknecht (1976) has mentioned that rarefying osteitis of the ossicles is a common complication of chronic infections. The long process of incus, crural arch of the stapes, body of the incus and manubrium are involved in that order of frequency.

According to Austin, the long process of the Incus commonly undergoes necrosis because of thrombotic disease of the mucosal vessels supplying the incus but when secondary squamous epithelium ingrowth has occurred, the arch of the stapes and the handle of the malleus may be destroyed by the formation of osteolytic enzymes or collagenases in the subepithelial connective tissue.

Funai H et al. (1992) evaluated 75 cases with attic cholesteatoma and classified extension into 5 groups as follows:

Group I	cholesteatoma limited to the attic.
Group II	cholesteatoma occupying both attic and aditus.
Group III	cholesteatoma extending down to the posterior tympanum plus an area as in group II
Group IV	cholesteatoma occupying the attic, the aditus and the mastoid antrum.
Group V	cholesteatoma extending down to the posterior tympanum, also an area as in group extending down to the posterior tympanum plus an area as in group IV.

2) HISTORY OF ENDOTOLOGY

The introduction of Otologic Microscopes has revolution in the otology not only in the diagnostic Otology but more importantly in the Otologic surgery. Structures in the Retrotympanum and Epitympanum were not visible to the Otomicroscope and therefore only be checked partly or through more invasive surgical approaches. The first attempt to visualize these hidden areas was performed by Zini who invented Stainless Steel Micromirrors by “Indirect Micro Tympanoscopy”.

Mer-et-al in (1967) was the first to use fiberoptic endoscopes through existing tympanic membrane perforation for studying the middle ear structures. Eichner (1978) introduced the use of rigid endoscopes with 2.7mm diameter with higher resolution. Willemot succeeded in visualizing the hypotympanum, protympanum, retrotympanum, attic by inserting 1.7mm endoscopes.

Nomura (1982) introduced the concept of passing right- angled needle endoscopes through a myringotomy. Gonzalez (1986) introduced 1.7mm 55^{o} endoscopes for identification of residual cholesteatoma during tympanomastoidectomy.

Kimura et al1 (1989) visualized Eustachian tube and limited portion of middle ear through nasal endoscopy. Jaques magnan (1990) explorated middle ear using Eustachian tube microendoscopes of size 0.9mm.

Takahashi (1990) utilized 1.7mm, 75^{o} rigid endoscopes to inspect tubal ostium of children undergoing myringotomy for placement of ventilation tubes. Thomassin (1993) used 2.7mm0^{o} and 70^{o} endoscopes for endoscopic guided otosurgery to prevent residual cholesteatoma at the end of microscopic procedure also did second look procedure through retroauricular approach with 4mm 0^o endoscopes. Concluded that rate of residual cholesteatoma reduced with endoscopes.

Poe (1994) utilized endoscopes for detecting perilymph fistula through exploratory tympanoplasty by 1.8mm 0^o and 30^o endoscopes. Rosenberg (1994) introduced endoscopes in acoustic neuroma surgery through retro sigmoid approach 4mm 30^o and 70^o. Tapio-et-al showed further areas could be examined by changing the angle of the fiberoptic and the place of incision in the tympanic membrane. For this he used 90^o and 30^o endoscopes.

Okada (1998) 0.5mm flexible fiberoptic endoscopes in determining probable margin of external auditory canal scc.wacym (1998) endoscopic assisted vestibular neurectomy in 10 patients with intractable meniers disease through retro-sigmoid craniotomy.

Karhuketo (1998) using flexible 0.8mm fiberscope defined 43 anatomic structures as viewed through Eustachian tubes in 10 cadaveric temporal bones. He also conducted endoscopic examination with 1.7mm 0^o , 30^o , 90^o ; 2.7mm 30^o, 70^o endoscopes in 151 ears with conduction hearing loss. In about 95% of cases endoscopic findings were confirmed by operation and in 17% it changed the management.

Friedland (1999) performed endoscopic auditory brain stem implantation with 4-mm 0^o, 30^o endoscopes in 5 cadaveric heads and concluded that retro-sigmoid approach better than translabyrinthine and middle cranial fossa approach, also superior visualization of fourth ventricle was possible with this technique.

M.Badr-el-dine (2002) published study on 92 ears with acquired cholesteatoma operated by him and concluded that incorporation of endoscopes into the surgical armamentarium contributes much to the concept of minimally invasive surgery, the use of endoscopes did reduce the residual cholesteatoma and the endoscopes should be accepted as a new horizon in ear surgery.

Shehzad Ghaffer(2006) conducted study to evaluate the use of pediatric rigid otoendoscope and concluded incorporating endoscopes enables complete visualization of middle ear and to check for ossicular integrity and mobility with distinctive advantage of decreased operating time and its optics are as clear as microscopes. Paula mayer (2007) concluded that endoscopic approach reduces the need for the second look mastoid surgeries in his study on 250 cholesteatoma cases of endoscopic guided microscopic surgery.

Cholesteatoma and middle ear physiology:

TAKAHASHI (2000) explained Middle ear physiology in relation to ventilation and pressure regulation. Like the lung, the middle ear is an organ that must maintain an aerated cavity within it for the fulfillment of its function. Bluestone et al. (1981) compared the Eustachian tube to the larynx and the middle ear and mastoid to the lung. He also pointed out the similarities of otitis media or atelectatic ear in the middle ear and pneumonia or atelectasis in the lungs. Pressure regulation by Transmucosal Gas exchange

Much attention has recently been paid to the fact that the middle ear is ventilated by gas exchange through the mucosa in the middle ear, particularly mastoid as well as by the Eustachian tube.

The “hydrops ex vacuo” theory (Zaufal 1870), which say the tubal obstruction causes absorption of oxygen in the middle ear resulting in the formation of progressive negative middle – ear pressure and effusion, had long been believed, and was supported by the experimental formation of middle – ear effusion by ligating the Eustachian tube in animals (Holmgren 1940). Since about 1970, however, several reports have emerged which cast doubt on this theory. Proud et al. (1971), monitoring middle – ear pressure for 24 – 36hrs after ligating the Eustachian tube in cats, failed to show a high negative pressure (over 90mmH_2O), and Cantekin et al. (1980) showed that the middle – ear pressure remained at approximately – 50mmH_2O when physiological respiration was maintained in dogs under general anesthesia. We also observed middle – ear pressures in cats for sever weeks by tympanograms, after selectively abolishing tubal ventilatory functions by transacting the tensor veli palatini muscle and hamulus pterygoideus, but failed to find the frequent formation of high negative middle – ear pressure or OME

(Honjo 1988;Takahashi et al.1990).

Since then, as if supporting the above –mentioned results, several reports have suggested middle – ear ventilation and pressure regulation system other than the Eustachian tube. Bylander et al. (1985) monitored the middle – ear pressure of children with tubal dysfunction for more than 24 h by tympanogram, and found that their middle ears showed alternate positive and negative pressures during sleeping and waking, respectively. Hergils et al (1985) found that the middle ear of many normal individual showed positive pressure when they woke up in the morning. Furthermore, Buckingham et al (1985), through middle – ear pressure monitoring of dogs under general anesthesia, demonstrated that the middle – ear pressure varied according to their respiratory condition: positive pressure during hypoventilation and negative pressure during hyperventilation.

More recently, the possible existence of a gas exchange function through the middle – ear mucosa has received much attention. Cantekin et al (1980) showed experimentally that the speed and degree of middle – ear pressure decrease in dogs depended upon the gas diffusion into the middle ears. Sade et al (1995) inflated various gases into the middle ears of patients with atelectatic drum and found that speed of normalization of protruded ear drums after inflation varied according to the gases inflated.

Sade et al. (1995) pointed out that the middle – ear gas composition is similar to that in the venous blood in humans, and later his colleagues (Leavy et al. 1995) directly detected inhaled inert gas in the middle ear. Thus, the existence of a gas exchange function through the middle – ear mucosa was confirmed.

Hergils et al. (1985) and Iwano et al. (1993) demonstrated in humans that applied negative and / or positive middle – ear pressures tend to approach atmospheric pressure if the person does not swallow, and observations with the same settings in normal individuals showed the same results.

When there is a difference in the partial pressure of any gas such as oxygen, nitrogen, or carbon dioxide between a closed space with in the body, such as the middle, and its surrounding tissue or blood, gases tend to move passively from where their partial pressures are high to where they are low in order to minimize the difference: in other words, they can move either towards the closed air space or towards the blood according to the partial pressure gradients. As a result, the total pressure of the closed air space tends to be kept at around atmospheric pressure. This passive movement of gases is the gas exchange.

The normal mucosa in the middle ear, particularly in the mastoid, has morphological features which are advantageous for gas exchange. Just underneath the single – layer simple squamous epithelium there is a rich distribution of capillaries and there is little interstitial tissue between them. Furthermore, observations of the mastoid mucosa by electron microscope show that between the mucosal epithelial cells there is a wide space where capillaries are almost exposed to the mastoid air space (Okubo 1993). This structure is similar to that observed in the alveoli in the lungs, and looks as if it would facilitate efficient gas exchange between the middle – ear cavity and the capillaries. Takahashi et al pointed out that:

- The middle ear should always be ventilated and its pressure regulated so that it can function as a sound conduction organ, and for this reason the middle ear has double ventilation and pressure regulation systems; the Eustachian tube and transmucosal gas exchange.
- The Eustachian tube function can be interpreted as active, quick and precise, this also has some disadvantages: it does not work during sleep, and it is easily impaired by upper respiratory tract infection, etc. it is for acute changes of pressure.
- The middle ear transmucosal gas exchange, which is a passive phenomenon through the middle – ear (mastoid) mucosa. This gas exchange is so slow that it cannot cope with a sudden change in

atmospheric pressure, but it has the advantage that it works constantly even during sleep. The gas exchange function is impaired by inflammatory thickening of the mucosa, and stops completely when the air space in the middle ear is lost.

- The ventilation and pressure regulation of the middle ear may be done mainly by the gas exchange function because the Eustachian tube also has two other functions, i.e., clearance and protection.
- So consideration should be given to these two ventilation and pressure regulation systems when we analyze middle –ear pathophysiology, or search for the appropriate management of middle – ear diseases.

Pathogenesis, pathophysiology and management of cholesteatoma form the viewpoint of middle – ear ventilation is summarized below:

- Impairment of ventilation and scar contraction in the mastoid due to mastoidectomy was considered to be one of the fundamental factors relating to the pathogenesis of postoperative cholesteatoma. The canal wall-up procedure with defect in the bony lateral wall of the attic appeared to be an additional predisposing factor.
- The irreversible impairment of mastoid ventilation (the gas exchange function) due to organic changes in inflammatory lesions in the mastoid, such as the formation of granulation tissue, may be one of the important pathogenetic factors of a cholesteatoma. A suppressed and

sclerotic mastoid, with resultant decrease in the surface area of lining mucosa probably resulting from a long history of otitis media since early childhood, may be a predisposing factor for the formation of the organic lesions in the mastoid.

- One difference between retraction pockets and cholesteatomas is the presence or absence of aeration in the mastoid: in other words, whether the mastoid gas exchange function is available or not. We should therefore consider mastoid aeration in the management of cholesteatoma. Cholesteatoma with mastoid aeration is worth treating conservatively at first. OME accompanying severe attic retraction may also be managed with a similar strategy, depending on the presence or absence of mastoid aeration after tympanostomy tube insertion.

Middle ear pathophysiology after ear surgery:

- After ear surgery, both the transmucosal gas exchange function & aeration in the mastoid are preserved (recovered) when the mastoid, and particularly the epitympanic, mucosa is preserved, while both are lost after mastoidectomy where all the normal mucosa was exenterated. Thus, the postoperative ventilatory condition in the mastoid depends heavily upon the treatment of the mastoid mucosa during surgery.

- The recovery of mastoid aeration after surgery is not significantly influenced by preoperative Eustachian tube function or by the use of a tympanostomy tube during surgery, but appears to be improved to some extent by the use of a large silicone sheet reaching to be mastoid, which favours regrowth of epithelium, prevents scar formation & adhesions thus facilitating recreation of normal middle ear space.
- Loss of the gas exchange function and aeration in the mastoid after mastoidectomy also causes retraction of the posterior EAC wall when it has been reconstructed with soft tissue only. However, retraction does not occur when the mastoid gas exchange function and aeration recover (owing to the preservation of mastoid mucosa). This mechanism of the retraction of a soft posterior EAC wall may be related to the pathogenesis of postoperative attic retraction and subsequent cholesteatoma formation.

When deciding on the appropriate mode of middle – ear surgery for otitis media, middle – ear ventilation, and particularly the transmucosal gas exchange function, must be considered. The results of our investigations and our recommended are summarized below.

Mastoidectomy results in no recovery of the gas exchange functions and aeration in the mastoid after surgery, although they do recover when the mastoid mucosa is preserved even partially, particularly if it is continuous. With attic mucosa which maintain the continuity of the maxillary transport mechanism facilitating the drainage of mucous & blood clots towards the protympany for the onward drainage into the Eustachian tube. And recreating air space in the attic & mastoid facilitate transmucosal gas exchange & reversal of retraction of the reconstructed posterior meatal softwall.

SOFT-WALL RECONSTRUCTION OF THE POSTERIOR CANAL WALL WITH MASTOID VENTILATION:

The canal-wall-down procedure and reconstruction of the EAC wall with soft tissue such as a remnant of EAC wall skin and a piece of temporalis fascia, as reported by Bennet (1981)and smith et al.(1986), is now becoming popular in Japan as well (Hosoi et al.1994,1998;Oshima et al.1995).

In some of the ears in which this procedure was used, the posterior EAC wall which was reconstructed with soft tissue has retracted to form a space like a radical cavity, but in most of others it has remained in the original position as if the canal wall up procedure had been used.

The generally recognized advantages of this procedure are summarized below:

1. A wider surgical view is obtained, as in the canal wall down procedure.

2. Much of the time and effort necessary for a hard tissue reconstruction, such as the trimming and fitting of the material, can be saved.
3. The area of the open wound is far smaller than in the canal wall down procedure: this means as shorter time for wound healing.

In terms of middle ear ventilation, this procedure is even more interesting and significant. When the ventilatory (gas exchange) and ciliary clearance function are preserved in the mastoid after surgery, the soft posterior EAC wall is kept in position without retraction owing to the recovery of aeration in the mastoid. Conversely, when these essential function fail to recover in the mastoid after surgery, the mastoid abandons to form an aerated cavity and choose scar contraction within the cavity to form a radical mastoid cavity. In other words, this procedure allows the residual functions within the mastoid cavity to control what will happen after surgery. This is why the most stable form of the mastoid compatible with its residual function is obtained, and unpleasant sequelae such as recurrent attic retraction or cholesteatomma do not usually occur. Therefore, if this procedure is used, surgeon do not have to worry about the choice of operation mode (canal –wall-up or canal –wall-down), and the middle ear settles down naturally to the most stable form possible after surgery. Thus, this procedure can be used in most cases requiring surgery for chronic otitis media.

Furthermore, this procedure can be applied not only in surgery for otitis media, but also for surgery of inflamed ears such as in facial decompression, cochlear implant, and ossiculoplasty for congenital or traumatic ossicular disruption (takahashi et al.1999). When ever it is difficult to preserve the bony posterior EAC wall during surgery for these diseases, it can be removed without hesitation if most of the intact mastoid and epitympanic mucosa can be preserved. Mastoid aeration usually recovers in the early postoperative period, and the posterior EAC wall does not retract even if it is not reconstructed or reinforced with hard tissue. In such non inflamed ears, it is usually easier to preserve the mastoid and epitympanic mucosa during surgery.

Reconstruction of the ear canal wall with ventilation of the mastoid cavity can be a dubious procedure, especially if ventilation of the cavity is insufficient at any stage following surgery. In such situations the ear canal wall, which has been reconstructed using soft tissue, may retract and adhere to the cavity walls, resulting in an “open” cavity, which is a reasonable outcome. However, in cases where reconstruction of the ear canal wall has been performed using hard tissues, such as autogenous bone or hydroxyapatite, retraction pockets may similarly occurs, located between the medical edge of the reconstructed ear canal wall and the drum, resulting in an unstable situation.

Muaaz Tarabichi (2000) conducted study on long term results of endoscopic management of cholesteatoma. In this study 69 ears with primary acquired cholesteatoma were divided into two groups, Group 1 include 38 patients with endoscopically accessible disease in which the sac could be easily elevated off the ossicles, middle ear, and attic. Residual attic and tympanic membrane defects were reconstructed with a composite tragal graft. Group 2 included 31 patients with extensive disease within the mastoid cavity proper wide transcanal atticotomy were performed, and the bony defect was enlarged into the antrum and was packed and left open. Residual tympanic membrane defects were reconstructed with composite tragal graft in 9 patients.

Mean years of follow-up was 41 months, with 69 ears observed for 5 years. In group 1 six ear required revision surgery, with 4 patients undergoing revision endoscopic procedures to convert into an open attic and antrum cavity and 2 patients undergoing classing canal wall down postauricular procedures. Nine ears in group 2 required office-based minor procedures, which included removal of some disease from the open attic, minimal curetting of bony regrowth to open up the closed antrum and attic, and incision of scarred skin and soft tissue and attic, and deflecting the edges into the underlying open bony cavity. Narrowing of the neck of the cavity was observed only during the first 8 months after surgery. There was only 1 case in which the open attic was closed significantly and the ear continued draining. This was addressed with postauricular canal wall down mastoidectomy. All other patients had healthy-looking shallow cavities.

Daniele marchioni and Francesco mattioli (2009) conducted study on 21 patients with limited acquired attic cholesteatoma operated by an endoscopic approach over a 1-year period; there were 17 males and 4 females, with a median, age of 38.4 years. Audiological testing showed an air-bone gap of 25 dB or more in 19 patients. Thus, 19/21 patients underwent an exclusively transcanal endoscopic approach; in 5 of these, it was necessary to change to a traditional microscopic approach, 2 patients underwent traditional microscopic meatoplasty followed by endoscopic approach.

Primary ossicular reconstruction, using autologous incus, was performed in 14/21 (66.7%) patients; 8/14 patients presented an ossicular chain erosion and in 6/14 the cholesteatoma sac was developed in the medial portion of the ossicluar chain and they removed the incus and the head of the malleus.

In 7/21 (33.3%) patients, where the cholesteatoma had involved only the anterior epitympanum, it was possible to eradicate the disease, without disarticulation of the ossicular chain. All 21 patients presented a cholesteatoma mass causing an isthmus block. In all 16 cases of complete tensor tympani fold with an isthmus block causing an exclusion of the anterior epitypanum we removed it, thus restoring anterior epitympanic ventilation. Audiological testing at the last follow – up visit for the individual patients showed closure of the air – bone gap to within 25 dB (average of the air-bone gap at 500,1000, and 2000 Hz) in 18 patients. In this series, there was no morbidity or complication secondary to the use of the endoscope in the middle ear.

H.TAKAHASHI (2000) In his study found Mastoid aeration recovered in 12 of 24 ears (50%) in which tympanostomy tubes had been used during surgery, but it also recovered in 15 of 33 ears (45%) without tympanostomy tubes, thus showing no significant correlation. Thus the facilitation of ventilation within the tympanic cavity by a tympanostomy tube does not necessarily affect the recovery of mastoid aeration.

Silicone sheets, 0-5mm thick, had been used during surgery in 36 of 57 ears in order to avoid adhesion and facilitate the recovery of aeration in the middle ear, but mastoid aeration recovered in only nine of these cases (25%). However, aeration recovered in 18 of the 21 ears (86%) in which silicone sheets had not been used, so it seems that silicone sheets do not contribute to the recovery of mastoid aeration.

In 49 ears which had undergone tympanomastoid surgery for chronic otitis media with or without cholesteatoma with the canal wall – down procedure, the posterior of EAC wall was reconstructed with soft tissue only, e.g., temporalis fascia (soft-wall reconstruction; Bennet 1981; Smith et al.1986), EAC wall was followed up for 12 months after surgery. Of the 49 ears 23 ears had notable retraction of surgically created soft wall of EAC in which the mastoid aeration was not significant. Where as significant aeration of mastoid was documented in 26 cases without any apparent retraction (n=17) or only slight retraction of the reconstructed soft wall.

Takahashi, Haruo; Hasebe “Soft-Wall Reconstruction for Cholesteatoma Surgery” The American Journal of Otology Issue: Volume 21(1), January 2000, pp 28-31.

52 patients (54 ears) with fresh cholesteatoma excluding residual and recurrent cholesteatomas, who underwent ear surgery with the soft-wall reconstruction. They consisted of 8 children and 44 adults (46 ears) with their age ranging from 5 to 72 years. During the surgery of those ears, the defect on the eardrum or the posterior EAC wall skin after removal of cholesteatoma was covered (reconstructed) by a piece of temporalis fascia . Tympanoplasty was done in all of these ears except two; in one stage in 18 ears and in two stages with an interval of 6 to 12 months in 34 ears. Ossicular chain was preserved in three ears (type I), the fascia was directly in contact with the head of the stapes in one ear (type III), and in all the remaining 48 ears autograft tissues (ossicle, cortical bone or auricular cartilage) were used for the reconstruction of conductive system; on the stapes head in 38 ears (modified type III) and on the stapes footplate in 10 ears (modified type IV).

Another group of 29 patients (29 ears) who underwent ear surgeries for cholesteatoma with canal-wall-down and open method were compared.

Regarding the period for complete epithelization after surgery, chronic discharging ear found in two (3.7%) in the soft-wall group and five (17.2%) in the open group, being greater in the latter, the period for epithelization was 31.5 ± 19.0 days in the soft-wall group, while it was 45.7 ± 23.1 (average ± SD) days in the open group, being significantly shorter in the soft-wall group than in the open group.

The mean air-bone gap was <15 dB in 32 of 48 ears (66.7%) and <20 dB in 38 of 48 ears (79.2%) in the soft-wall group, while they were 13 of 24 ears (54.1%) and 20 of 24 ears (83.3%), respectively in the open group, having no significant difference between the two groups. In 14 ears with >20 dB air-bone gap, type IV tympanoplasty had been done in 6 of 10 ears (60%) in the soft-wall group and in 2 of 4 ears (50%) in the open group.

Incidences of residual and recurrent cholesteatomas were 11.1% (6/54 ears) and 1.9% (1/54 ears), respectively in the soft-wall group, while they were 24.1% (7/29 ears) and 0%, respectively in the open group, showing no significant difference between the two groups.

J. Sade (1992) explained about the correlation of middle ear aeration with mastoid pneumatization. He stated that Cholesteatomatous ears in which middle ear is poorly aerated usually possess poorly pneumatized or non-pneumatized temporal bones. The middle ear is a gas pocket which strives to maintain an atomospheric pressure (760mmHg) while its gases tend to diffuse into the tissue where the pressure is only 706 mmHg. Thus the middle ear has a constant tendency towards a slight negative pressure which probably is constantly at a delicate balance as seen from its tendency to fluctuate up and down. Waxing and waning of middle ear pressure probably represents a normal physiological situation .Mastoid pneumatization may be viewed as a buffer system against changes in middle ear pressure. People with pneumatic mastoids i.e., the normal population, are thus relatively resistant to atelectasis and its associated effects. A non-pneumatized mastoid possesses no such pressure buffer, and the middle ear will therefore be more vulnerable to fluctuations in pressure, and are at risk for atelectasis and retraction pocket cholesteatoma .

Richards et al., who used the fact the N20 is a gas which diffuses Quickly into the middle ear. This has been shown experimentally and is also observed during myringoplasty surgery when it may be seen to lift the graft - a fact which often brings the surgeon to request the anesthetist to reduce N20 flow at the end of his surgery. Richard et al. correlated the tympanometric values measured during N20 anesthesia with the type of the mastoid of their patients and found higher pressure values for sclerotic mastoids.

The difference is vascularisation between the middle ear and the mastoid cellular system which makes the mastoid space a gas container that plays a relatively less active role in diffusion and therefore has a relatively larger and important pressure dumping effect. Would the mastoid vascularisation be richer than usual, its pressure buffering effect would be reduced. An increase in vascularisation is the consequence of inflammation.

OBSERVATIONS

Statistical analysis was done for quantitative variables like age, incidence and percentages were calculated .The study consist of 35 patients with chronic suppurative otitis media with cholesteatoma who were evaluated completely taking into consideration a number of parameters. The observations made during the study were as follows:

Age and sex distribution:

Age in yrs	No.of Cases	Female	Male
11-20	11(31%)	5 (14%)	6(17%)
21-30	15(43%)	7 (22.8%)	8(20%)
31-40	9 (26%)	6 (17%)	3(8.5%)

In our study the youngest patient was 11yrs old and the oldest was 40 yrs as shown in the table the maximum incidence was in the third decade i.e.., 15 cases (43%) followed by second decade which was 11 cases(31%) and the distribution in the fourth decade was 9 cases(26%).the mean age in this study was 24years.

Clinical features:

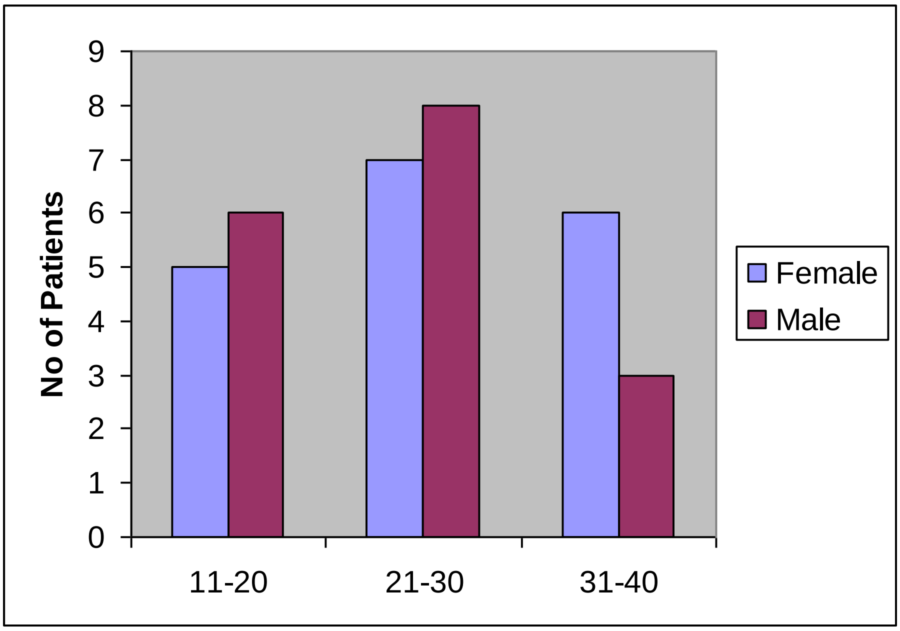
Symptoms	No .of patients	Percentage
Ottorrhea	31	88.5%
Hard of hearing	28	80%
Tinnitus	4	11.5%
Vertigo	4	11.5%
Otalgia	6	17%

Otorrhoea		
Type	**No. of patients**	**Percentage**
Persistant	17	48.5%

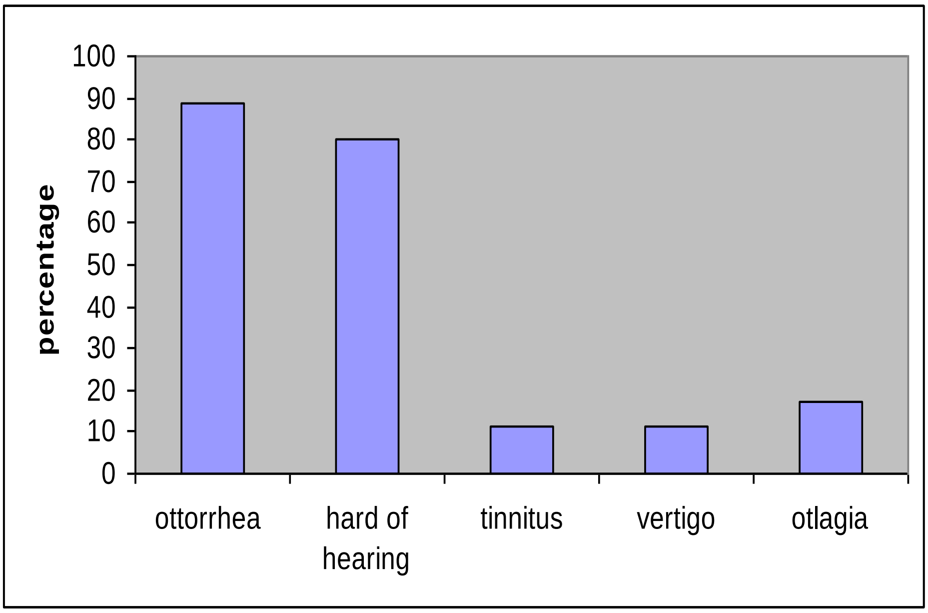
Occasional	14	40%
Dry	4	11.5%

In about 48% of the patients the disease was in active stage with persistent aural discharge. 40% patients had occasional discharge and 11.5% had no complaints of discharge at presentation.

Age and sex distribution



Clinical Features



According to WHO (1980) classification on the basis of puretone audiogram the average threshold of hearing frequencies at 500,1000, 2000Hz were taken for assessing the hearing loss.

1. Mild - 26-40db
2. Moderate – 41-55
3. Moderately severe – 56-70db
4. Severer – 71-91db.
5. Profound – more than 91db
6. Total

Duration of ear discharge and hard of hearing:

Duration	No. of patients	H/O HOH	Degree of HL by Puretone audiogram.	
			Attic type	Sinus type
Less than 1 year	5	2	M-2	M-1, Md-2
1-5 years	7	4	M-1, Md-1	M-2 , Md-3
5-10 years	5	3	M-1, Md-1	M-1 Md-2
More than 10 years	4	4	Md-2	Md-2
Childhood	10	10	Md-2 , Ms-2	Md-2 , Ms-4

HOH–hard of hearing. M- Mild, Md – Moderate, Ms- Moderately severe

Of the 35 patients 31 presented with complaints of discharge. Among these 31 patients 28 had associated hard of hearing. The duration of discharge also compared with degree of hearing loss measured by puretone audiogram.

The table shows that longer duration of ear discharge (disease) increases the severity of the disease of the hearing loss. However the loss greater in sinus cholesteatoma than in the attic cholesteatoma even though the duration of discharge was less. This is due to involvement of the ossicular chain (at the IS joint) frequently by the sinus cholesteatoma because of its strategic location.

EXTERNAL AUDITORY CANAL		
Grading	**No. of cases**	**Percentage**
Grade 1	18	51.5%
Grade 2	11	31.5%
Grade 3	6	17%

Grade – 1 complete visualsation of tympanic membrane without any manipulation (tilting of endoscope).

Grade -2 complete visualsation of tympanic membrane with some manipulation.

Grade- 3 partial visualization even with manipulation.

Otoscopic finding:

Otoscopic findings of PARS-FLACCIDA		
Findings	**No. of cases**	**Percentage**
PSQRP	23	66%
Attic perforation	7	20%
Attic granulation	5	14%

Among the 35 cases 23 cases (66%) had postero superior quadrant retraction pocket with cholesteatoma, about 12 patients had findings in the attic region of these 7 patients (20%) had attic perforation , 5 patients (8%) had attic granulation .

Ipsilateral and contralateral otoscopic findings in PARSTENSA:

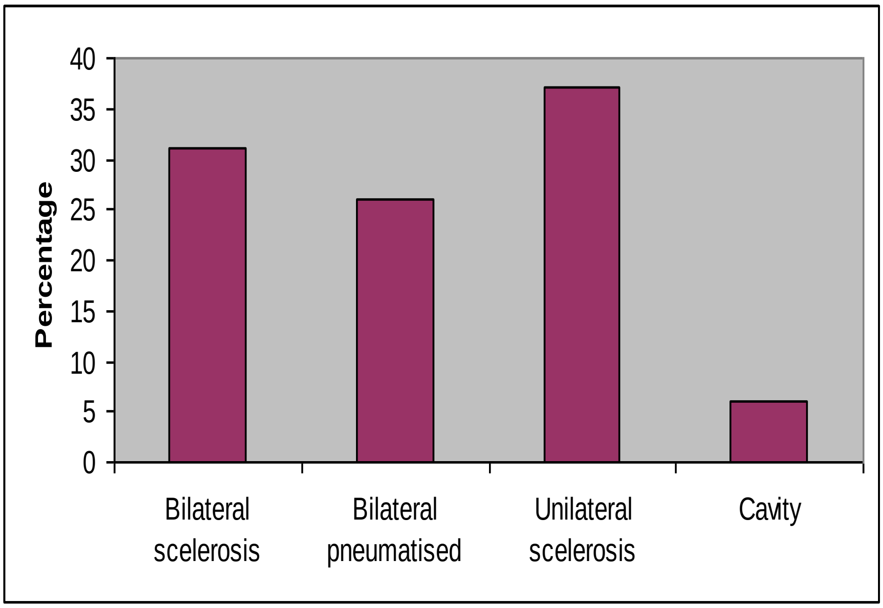
Pars tensa	**Ipsilateral Ear (No. of Patients)**	**Contralateral Ear (No. of Patients)**
Normal	11(31%)	18(51%)
Retracted	19(55%)	14(40%)
Perforated	5(14%)	3(9%)

On the ipsilateral side in 19/35 (55%) of patients had retracted parstensa, among these 19 patients 2 cases (5%) had retracted parstensa tympanic membrane directly resting over the head of stapes. 14% of patients had same side central perforation, 31% had normal healthy tympanic membrane. In the contralateral side retraction noticed in 40%, perforation in 9% and about 51% had normal tympanic membrane.

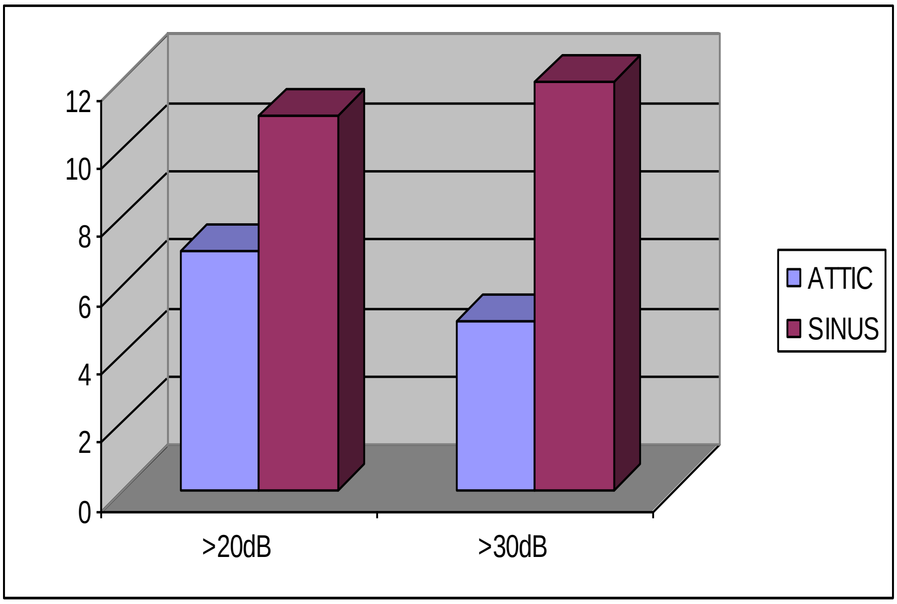
X-RAY MASTOID		
Mastoid	**No. Of cases**	**Percentage**
Bilateral sclerosis	11	31%
Bilateral pneumatised	9	26%
Unilateral sclerosis	13	37%
Cavity	2	6%

Of the 35 cases bilateral sclerosis noted in about 31% and unilateral sclerosis on the affected side in 37% of cases. Bilaterally Pneumatised mastoid noted in 26% of the patients. The cavitary lesion diagnosed in only 6% of the cases.

X-RAY MASTOID



Pre – op A-B gap



. Laterality of disease		
SIDE	**NO.OF CASES**	**PERCENTAGE**
Left		
Sclerosis	11	31%
Pneumatised	5	14%
Right		
Sclerosis	8	23%
Pneumatised	5	14%
Bilateral	6	17%

Pre – op A-B gap:

Type of cholesteatoma	>20dB	>30dB
ATTIC	7	5
SINUS	11	12

Majority of our patients was in the moderate range (41-55) (18/35) 51%. Thus sinus cholesteatoma causes greater amount of hearing loss.

Conduction Hearing Loss : AC >25dB A-B gap >20dB

Mixed Hearing Loss : BC > 25dB A-B gap >20 dB.

Type of hearing loss	No. of patients	Percentage
Conductive hearing loss	22	66%
Mixed hearing loss	13	33%

Pure conduction Hearing loss implies more than 25db air conduction loss and A-B gap of more than 20db and in the mixed variety the bone conduction loss of more than 25db and A-B gap more than 20db. In our study 66% of patients had Pure CHL and 33% had MHL.

SURGICAL APPROACH		
Approach	**No. of cases**	**Percentage**
Transcanal	33	94%
Postaural conversion	2	6%

33/35 patients underwent direct endoscopic transcanal approach, remaining 2 patients (6%) were converted to postaural approach because of extensive disease. Among 33 patients who underwent transcanal procedures 4 had anterior hump, which was not considered as a limiting factor in endoscopic procedure.

OSSICULAR STATUS – AUSTIN CLASSIFICATION		
Ossicle	**NO. of patients**	**Percentage**
M+S+	10	74%
M+S-	11	40%
M-S+	4	26%
M-S-	5	14%

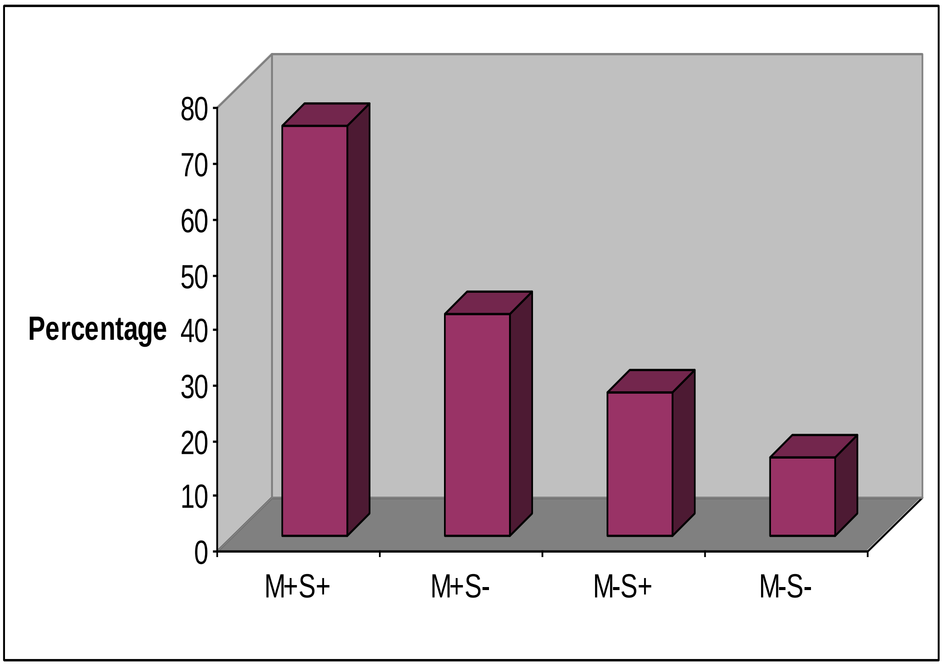
M- Malleus S-Stapes.

Incus because of the nature of its blood of supply and its location was the most common ossicle necrosed in all the cases , next is the suprastructure of stapes was in about 49% absent partial necrosis of malleus head was noted in about 26% of the patients.

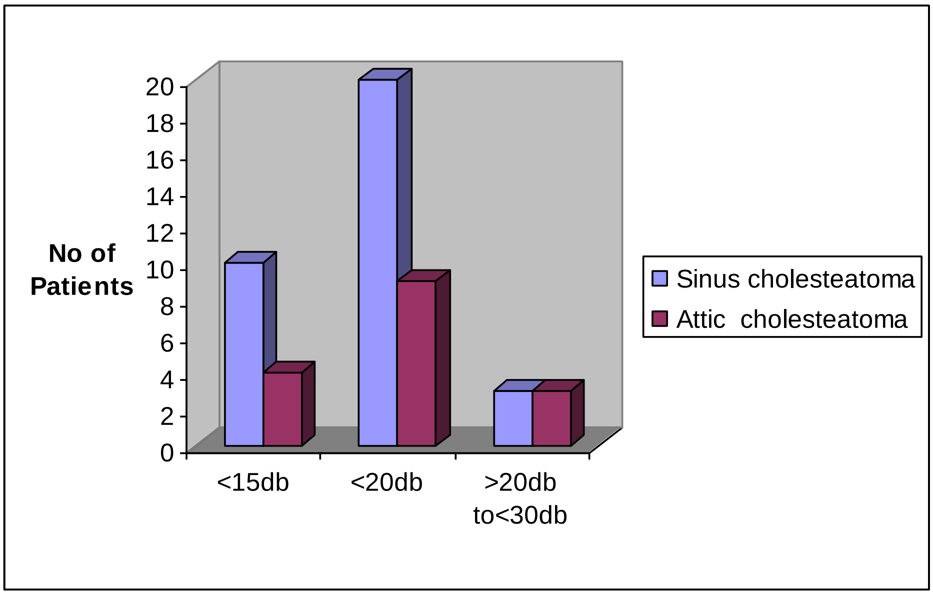
Incus erosion and the type of cholestetoma:

Type of Cholesteatoma	No. of patients with Incus erosion	Percentage of Patients with Incus erosion
SINUS	23	66%
ATTIC	12	34%

Ossicular Status – Austin Classification



Post operative A-B gap closure



Extent of the disease:

Extent	No.of patients	Percentage
Posterior tympanum	6/35	17%
Attic	4/35	11%
Attic+ aditus	4/35	11%
Attic+aditus+antrum	4/35	11%
Attic+aditus+antrum+ Posterior tympanum	7/35	20%
Posterior mesotympanum Attic+Aditus+ Antrum+ Tip cells	10/35	28.5%

Type of cholesteatoma.	**No. of patients.**	**Percentage.**
Attic type:		
Medial to ossicular chain.	6	17%
Supratubal recess.	4	11%
Sinus type:		
Facial recess.	12	34%
Sinus tympani.		
S+ (intercrural)	4	11%
S-(over footplate)	6	17%

Surgical procedure:

Surgical Procedure	No. of cases	percentage
CWD/AT (S-)	12	34%
CWD/AT (S+)	11	31%
Atticotomy/AT	4	11%
Marginectomy/AT	6	17%
CWD without AT	2	5%

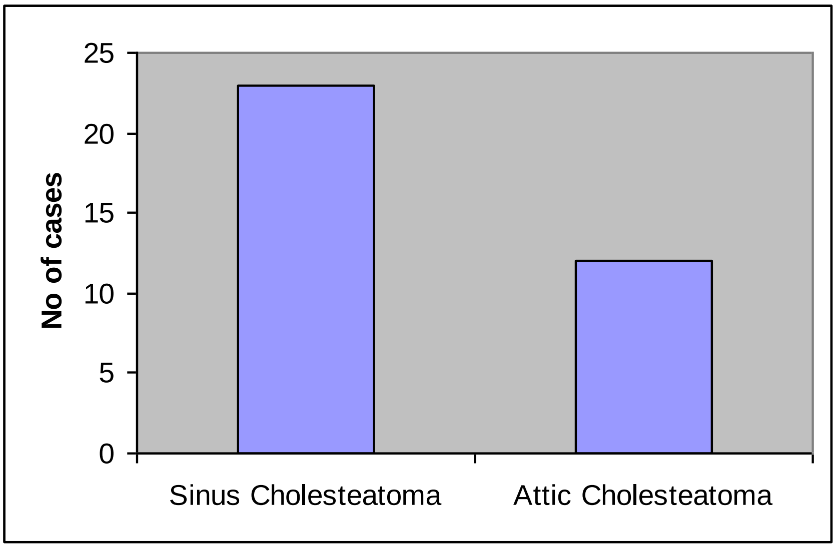
CWD- Canal wall down. AT- Augmented Tympanoplasty

Depending on the extent of the disease various surgical procedures were adopted about 65% of patient underwent canal wall down procedure with augumented tympanoplasty with autologous incus and cartilage graft placed over head of stapes in 31% and over footplate of stapes in 34% of patients .17% of the patient with limited cholesteatoma disease confined to posterior mesotympanum underwent marginectomy with tympanoplasty about 11% had atticotomy with tympanoplasty. In 2 patients tympanoplasty was postponed.

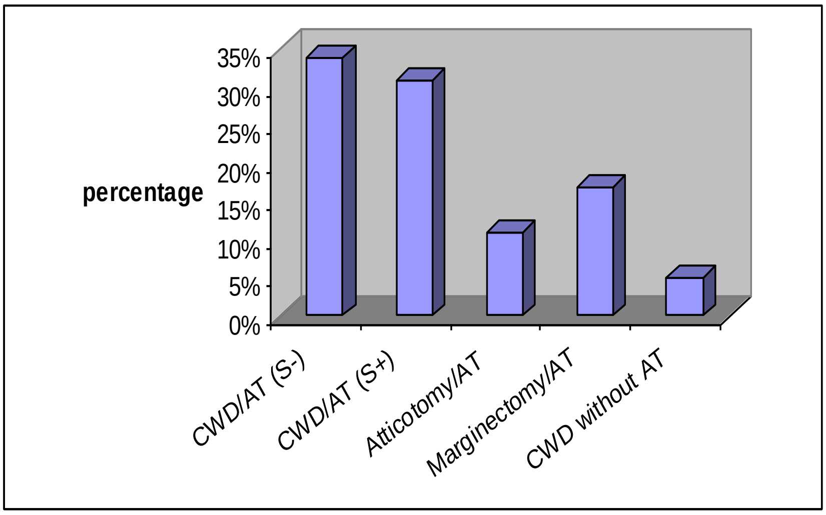
Post operative A-B gap closure:

Type of disease	<15db	<20db	>20db to<30db
Sinus cholesteatoma	10	20	3
Attic cholesteatoma	4	9	3

Otoscopic finding



Surgical procedure



POST OP COMPLICATIONS		
Complications	**No. of cases**	**percentage**
Canal Stenosis	4	11%
Post op infections	7	21%

Immediate postoperative complication including canal stenosis and postoperative infection in 11% and 21% respectively.

Softwall Retraction:

	Posterior canal wall retraction					
	complete		partial		nil	
Mastoid aeration	2m	6m	2m	6m	2m	6m
(+)	0	0	9	8	16	19
(-)	10	8	0	0	0	0

Postoperative infection vs healing time	
Postoperative infection	Average healing time
Infection +	32 days
Infection -	24days

The average healing time among the post infection group was 32 days and among the non infected group was 24 days. The minimum healing time documented was 18 days in the non-infection group and the maximum was 38 days in the infected group.

Middle ear aeration and hearing outcome		
Type of cholesteatoma	**Mastoid aeration**	**A-B gap <20db at 6month**
Attic	(+)	7
	(-)	2
sinus	(+)	17
	(-)	3

Mucosa preservation		**Position of softwall at 6 months**		
Site upto	**No. of patients**	**Stable**	**Partial retraction**	**Full retraction**
Attic	4	4	--	--
Mesotympanum	6	3	3	--
Antrum	15	8	3	4
Mastoid Tip cell	10	4	2	4

Status of middle ear mucosa:

middle ear mucosa	Healthy mucosa	polypoidal	Granulation
No.of patients	10/35	17/35	8/35
Percentage	28%	48.5%	22%
Post OP mastoid aeration	10/35	13/35	4/35

Condition of the middle ear mucosa on the diseased side was assessed. The mucosa was normal and healthy in about 28% of the patients. 48.5% patients had polypoidal changes and granulation in about 22%, in our study these changes of mucosa are considered reversible and are preserved during surgery for the future ventilation of middle ear and mastoid cavities. The post of mastoid aeration recovery was maximum in the 10 patients with healthy middle ear and mastoid mucosa.

DISCUSSION

Management of cholesteatoma is one of the challenging task in otology as the chance for residual disease and the morbidity of the conventional procedures involved in the cholesteatoma treatment are high. With incorporation of endoscopes in the otologic field much of the recidivism and morbidity of the procedures has been reduced.

As stated by Takahashi (2000) middle ear pressure is maintained by two routes, the Eustachian tube and the middle ear mucosal gas exchange. Ventilation through Eustachian tube is quick and active mechanism that helps in adapting to transient fluctuations in middle ear pressure. The middle ear mucosal gas exchange is passive and constant phenomenon, that functions even during sleep (Eustachian tube closed during sleep) helps in continuous maintenance of middle ear pressure .In our present study apart from the eradication of disease and reconstruction of the middle ear much importance has been given to the preservation of middle ear cleft mucosa and restoration of ventilation of middle ear and mastoid .

The age/ sex category of the patients involved in our study compared with other studies are as tabulated below:

Age & Sex					
	Total Cases	**Male**	**Female**	**Age Category**	**Median Age**
Tarabichi 1997	38	15	23	17-51	35
D.Marchioni et. 2009	21	4	17	15-50	38.4
Present Study 2010	35	18	17	11-40	24

S.I.Haginomori 2009 conducted study on 78 patients with cholesteatoma of which 45 had attic cholesteatoma and 33 had sinus type of cholesteatoma .In our present study about 23/35(65%) of the patients belong to the sinus cholesteatoma type and the rest 12/35 (35%) were attic type .this also compared with other studies in the following table:

Type of cholesteatoma:

year	study	Attic cholesteatoma	Sinus /extensive cholesteatoma
2000	Tarabichi.	38/69	31/69
2009	D. Marchioni	21/87	66/87
2009	S-I Haginomori	45/78	33/78
2010	Present	9/35	23/35

Activity of the disease at the time of presentation compared with Takahashi 2000 study compared to Takahshi2000.

year	study	Retraction pocket	Dry ear	Wet ear
2000	Takahashi	20/79	16/79	43/79
2010	Present	3/35	7/35	20/35

jacob.sade (1992) stated that cholesteatomous ears usually possess poorly pneumatised or non pneumatised temporal bones, in our study about 67% of our patient had sclerosed mastoid, that reduces the middle ear buffering capacity.

19/25 patients in D.Marchioni (2009) study underwent transcanal procedures among these 5/19 patients were converted to postaural approach 2 patients underwent traditional microscopic procedures. In our study 33/35 patients underwent exclusive transcanal approach and the rest of the 2/35 patients were converted to post-aural approach in view of extensive disease. 6 patients with grade 3 type of external auditory canal underwent canalplasty. 4 out of 35 patients had anterior canal wall hump, which did not obstruct the endoscopic visualization of tympanic membrane. Thus presence anterior canal wall hump not considered as a limiting factor in endoscopic surgery.

Surgical Approach			
study	**Transcanal approach**	**Postaural conversion**	**% of postaural conversion**
Tarabichi 1997	36	2	5%
D.Marchioni et.al, 2009	19	5	19%
Present Study 2010	33	2	5%

Extent of disease:

year	study	attic	Sinus tympani	upto Antrum	Mastoid tip
2000	Tarabichi	38/69	-	28/69	3/69
2009	D.Marchioni	21/87		66/87	
2010	Present	6/35	7/35	12/35	10/35

Takashi 2000 used tympanostomy tube in patients and 0.5mm silicon sheets in the tympanic cavity and found no significance in the recovery of mastoid aeration with tympanostomy tubes but silicon sheets found to have some significance in the recovery of middle ear mucosa when used in large size to cover the middle ear mucosal cleft from Eustachian tube orifice to mastoid antrum but in our study we have not used silicon sheets in any of the patients instead we used cartilage in the middle ear to augment the myringoplasty.

Advantages of the cartilage tympanoplasty is that it helps in restoration of the middle ear air space enabling the drainage of blood clot and other collection from attic, aditus, antrum ,anterior epitympanum via the middle ear into the Eustachian tube to the pharynx. This may help the mucosa to regain its normal ventilatory function facilitating the uplift and stability of the soft wall if it was retracted previously because of the antral collection. The tympanic membrane goes for perforation when cartilages other than handle of malleus comes into direct contact with it but in cartilage tympanoplasty where the composite cartilage placed between the ossicular graft and tympanic membrane overcomes this disadvantage.

Atticotomy:

In all our procedures bone removal was carried out with curette especially in the attic region as the use of power drill in this site has a great chance of sensorineural hearing loss and danger of facial nerve palsy expected with drilling. Drilling is done as we go posteriorly towards the antrum, with low speed if at all used. Diamond burr is used for controlling bleeding and for smoothening the bony margin edges. Use of short shaft burr is preferred as there is decreased chance of lateral canal skin injury and prevents the complication of canal stenosis. Following atticotomy in Tarabichi (2000) technique the defect is closed with tragal composite graft but in our technique we routinely use temporalis fascia for attic reconstruction and cartilage graft for the middle ear again the advantage of preservation of epitymanic mucosa and the reversal of mucosal gas exchange and ventilation physiology.

Attico-antrostomy:

For extensive disease involving the antrum and mastoid air cells Tarabichi 2000 adopted a open cavity technique that is to create 2 separate cavities the middle ear and mastoid cavity and this open cavity procedure required routine office based procedures in 9/31 patients such as removal of disease from the open attic cavity, curetting of the bony regrowth to open up the closed antrum and attic and incision of scarred skin and soft tissue and deflecting the edges into the underlying open cavity . Narrowing of the neck of the cavity occurred in the initial period of postoperative follow up and in one of the cases the cavity got completely obliterated. But in our technique there is no separate cavity instead the middle ear cleft is recreated and the near normal anatomy restored by the softwall reconstruction and so far we have not encountered any problems, also necessity for any such postoperative office based procedures is rare.

Above all the open cavity with a high facial ridge as in Tarabichi 2000 leads to a incompletely draining, non functioning mastoid that leads to accumulation of debris, secondary infection and residual conduction hearing loss. In our technique every attempt is made to preserve the middle ear mucosa so that mastoid mucosal functions returns facilitating the drainage, middle ear aeration and better conduction of sound.

Instruments used by Tarabichi (2000) were specially designed with most of the pick, elevators and curettes having a 20 degree deflection at 1cm from the tip of instrument but in our practice we used routine micro ear surgical instruments making use the advantage of endoscopes to view beyond the shaft of the instruments.

Frequent irrigation with saline helps in clearing the debris, bone dust and bacterial contaminations. This basic and simple procedure has great advantage in early healing and mucosal recovery. Regular irrigation, frequent cleaning of the tip with antifog solution light source with low setting reduces the excessive heat dissipation at the tip of the endoscope.

MASTOID MUCOSA:

year	**study**	**Mastoid mucosa preserved (total no.of cases)**	**Masoid aeration recovered in**
2000	Takahashi	54	26/54 (70%)
2009	S-I.Haginomori	78	36/78 (46%)
2010	Present	33 +(2 MRM)	25/35 (80%)

The recovery of mastoid mucosal function and the mastoid aeration is high when much of the middle ear cleft mucosa is preserved and in our study the presence mastoid aeration was assessed by the softwall position and it was 80% when compared to other studies, Takahashi 2000 70% and S.I.Haginomori is 46%, the probable reason may be that all our procedures were done with endoscopes and necessity to remove uninvolved bone and normal mucosa is minimal. In other two studies with softwall reconstruction all procedures were done with microscopes were excess bone were removed to gain access to the disease.

After the complete cholesteatoma clearance primary ossicular reconstruction is done in all 33/35 cases with autologus incus and with middle ear cartilage graft, in the remaining 2/35 patients ossicular reconstruction was postponed. This compared to other studies in D.Marchioni 2009 primary ossicular reconstruction was 14/21 and secondary 7/21, Takahashi(2000) did staged reconstructions in 18/52 (stage1) and 34/52(stage 2) and no ossicular reconstruction in 2/52, thus higher incidence of primary reconstruction procedure documented in our study. This was possible because of complete clearance of the disease from all inaccessible sites including 4 cases where disease was removed from the intercrural space without disturbing the stapedial arch.

In S.I.Haginomori study 57/78 patients underwent type III tympanoplasty with autologus incus placed over the head of stapes and in 21/78 patients incus placed over the footplate of stapes , in Takahashi (2000) placed incus over head of stapes and foot plate 70% and 18% respectively.

In our study about 11/35 (35%) patients underwent augmented tympanoplaty with incus over head of stapes and in 14/35 (40%) incus placed over footplate with interposed cartilage graft between this and the tympanic membrane.

Ossicular reconstruction:

YEAR	STUDY	PRIMARY	SECONDARY
1997	Tarabichi	19/38	19/38
2009	D.Marchioni	14/21	7/21
2010	Present	33/35	2/35

Mastoid aeration:

A highly significant correlation was found between the preservation of mastoid mucosa and the recovery of mastoid aeration. Takahashi et al reported Mastoid aeration recovery in 70% in which intact mastoid mucosa had been preserved to some extent during surgery, while it recovered in only 17% mastoidectomized ears. In our study we restrict our dissection only to the extension of the cholesteatoma with minimal removal of the inflamed mucosa, because of this more than 85% of our patient had early recovery of mastoid aeration. When considering the site where the mucosa had been preserved in the mastoid during surgery, the epitympanum was found to have the highest correlation with the recovery of mastoid aeration. Thus, the importance of preserving the mastoid, particularly epitympanic mucosa, during surgery was reconfirmed as reported by Takahashi. In our study we always ensure preservation of mucosa particularly in the medial wall of the attic, aditus and atleast a tail of mucosa in the antrum if the disease has extended upto the tip of mastoid.

SOFTWALL RECONSTRUCTION:

Soft-wall reconstruction was first reported by Smith et al. In this method, after the posterior EAC wall skin is preserved as much as possible, the defect on the eardrum and posterior EAC wall after removal of cholesteatoma is reconstructed by a soft tissue such as temporalis fascia. As advantages of the soft-wall reconstruction method, Smith et al. stated early postoperative cure of the wound and its technical ease and little addition to operating time. In this study at one year follow there was no incidence of the chronically draining ears or any recidivism with this technique.

Complete epithelisation of EAC:

As stated by Smith et al. one of the major advantages of softwall reconstruction is early postoperative epithelisation of EAC, but they did not demonstrate it with their data. Takahashi et al 2000 in his study on softwall for cholesteatoma compared the postoperative recovery of EAC epithelisation between two canal-wall-down groups, one with softwall reconstruction and other open method, the period for epithelisation was 31.5 ± 19.0 days in the soft-wall group, while it was 45.7 ± 23.1 days in the open group, being significantly shorter in the soft-wall group than in the open group. In our study the average time for epithelisation of EAC found to be 28±10 days.

According to Takahashi et al 2000 number of ears that remained wet for years after surgery (chronically draining ear) were two (3.7%) in the soft-wall group and five (17.2%) in the open group, being greater in the latter. In our study in one year follow up we have not encountered any case chronic discharging ear so far. Appropriate apposition of the canal skin incision and smaller area of the raw surface of the intraaural wound in our method may be attributed to less frequent chance of bacterial contamination and shorter time for cure of the wound. In none of our cases, a defect or perforation occurred on the soft posterior EAC wall because of infection or necrosis of the graft after surgery.

Postoperative condition of the softwall:

Takahashi et al noted complete retraction of softwall like typical canal wall down mastoidectomy cavity in 26/54, slight benign looking retraction in 10/54 and no retraction in 18/54 cases . In our study 10/35 had complete retraction , 9/35 slight retraction , 16/35 had no retraction . Degree of retraction of softwall:

Study	**Complete retraction**	**Slight Retraction**	**Nil retraction**
Takahashi 2000	26/54 (48.2%)	10/54(18.5%)	18/54(33.3%)
Our study 2010	10/35(28.5%)	9/35(25.7%)	16/35(45.7%)

Such postoperative behavior of the soft EAC wall seems interesting from the viewpoint of the middle ear physiology. No or only slight retraction of the soft wall was observed in most ears with positive mastoid aeration after surgery, while mastoid aeration was not observed in ears with complete retraction. The complete retraction occurred in bout 10 patients who had disease extension up to the tip. Because in such extensive disease the soft wall may not well supported and may go for complete retraction. Takahashi (2000) reported that postoperative recovery of mastoid aeration was correlated well with recovery of gas exchange function of the mastoid mucosa that was intact and preserved during the surgery. This seems to indicate that the soft posterior EAC wall retracts after surgery when the mastoid is incapable of ventilating itself, and the wall does not retract with recovery of mastoid aeration when the mastoid is capable of it. This is why the most stable form of the mastoid suitable for its function is obtained after surgery with soft-wall reconstruction, and unpleasant sequelae against surgeon's intention such as recurrent retraction pocket and cholesteatoma seldom occurs.

Softwall stability depends exclusively on the reaeration of the mastoid and in our procedures we make sure complete removal of cholesteatoma and retain as much middle ear mucosa as possible. The soft-wall reconstruction method is found to be a versatile method for cholesteatoma surgery compared with the canal-wall-down method in that healing of wound is earlier preserving the same advantages of the latter method such as low incidence of residual and recurrent cholesteateatoma.

Middle ear aeration and hearing outcome:

S.I.Haginomori et al 2009 documented adequate aeration of mastoid in which post operative A-B gap was less than 20db. In our study 29/35 patients had post operative A-B gap <20db in which adequate mastoid aeration was evident. In terms of differences in hearing outcome between reaerated and non -aerated cavities, soft-reconstructed EAC wall with reaerated mastoid cavity would allow proper movement of the autologous incus placed between tympanic membrane and the stapes resulting in proper conduction of sound. In non aerated mastoid the posterior EAC wall would retract restricting the movement of the reconstructed ossicular chain and leading to conductive hearing impairment.

Air-Bone gap:

year	study	Preop A-B gap(>25db)	Postop A-Bgap(<20db)
2000	Takahashi	36/48	38/48
2009	D.Marchioni	19/21	18/21
2009	S.I.Haginomori	18/78	45/78
2010	Present	21/35	24/35

The postoperative audiogram results of our study is better than when compared to the Tarabichi 2000 because the functional mastoid ventilating the middle ear adds to conduction mechanism , whereas in open cavity technique the dysfunctional mastoid does not facilitate sound conduction.

In our study most of the curetting or drilling or done lateral to the cholesteatoma that is we always stay lateral to the cholesteatoma and the bone removed is the lateral part of the mastoid without touching the medial wall so the chance of facial palsy or labyrinthine fistula as not occurred.

Incidence of residual and recurrent disease:

In Takahashi (2000) study, the incidence of postoperative recurrent (1.9%) and residual cholesteatoma (11.1%) was similar in both the soft-wall group and open cavity group. Tarabichi (2000) in his study documented residual cholesteatoma in 1/31 extensive disease in the retrotympanum .In our study in one year period of follow up we have not encountered any recurrent or residual disease so far. The low residual disease is possible because of the advantage of endoscopes that uncovers the inaccessible and hidden areas with relative ease. The postoperative retraction of the soft EAC wall generally occurs in the whole part of the soft wall, ultimately forming a large epithelized space like a typical canal wall down mastoid cavity thus obviating any chance of retraction pocket and formation of cholesteatoma

POSTOPERATIVE follow up:

	Period of Follow-up	**Chronic discharging ear**	**Healing time (days)**	**residual or recurrant**
Takahashi 2000	2-yr	2/54 (3.7%)	31.5+/- 19	6/54 (11.1%)
Our study 2010	1-yr	-	27+/-10	-

So far in our 1 year follow up we have not encountered any residual, recurrent disease or any chronically discharging ear, also the healing time (period for complete epithelization of cavity) was also less in 27+/-10 days compared to Takahashi 2000 were it was 31.5+/-19days. All our procedures were done exclusively with endoscopes where the need for bone removal for accessing is less compared to the Takahashi (2000) procedures which were done exclusively with microscopes, excessive bone and mucosal removal.

CONCLUSION

1. Endoscopic Tympanomastoidectomy for atticoantral type of CSOM is an excellent technique for complete removal of cholesteatoma especially from inaccessible areas of middle ear cleft including facial recess, sinustympani

2. Transmeatal removal of disease from mastoid antrum and even tip cells is possible with endoscopes.

3. Preservation of as much of normal mucosa of the middle ear cleft is possible with this technique, which promotes early reaeration of the mastoid cavity leading to better hearing outcome.

4. Soft wall reconstruction has distinctive advantage of short additional time for reconstruction procedures, restoration of self cleaning EAC, early post operative epithelisation of tympanic membrane and the EAC.

5. Limitation of endoscopic technique: The endoscopic technique of tympanomastoidectomy with softwall reconstruction is not possible in cases with large mastoid cavity and in ears where a thin lateral rim of bony meatal wall (that can support soft wall) is retained, because of extensive disease.

6. Like Functional Endoscopic sinus surgery (FESS) for nose, Endoscopes have changed the treatment concept of atticoantral disease, with complete removal of the disease and preservation of normal mucosa, that restores the normal physiology of middle ear cleft. This has led to the development of new concept of Functional Endoscopic Ear Surgery (**FEES**) for atticoantral type of CSOM.

STUDY ON ENDOSCOPIC TYMPANOMASTOID SURGERY

NAME: AGE/SEX:

OCCUPATION: OP/IP.NO:

ADDRESS: DOA:

DOS:

DOD:

CHIEF COMPLAINTS:

Ear discharge:

	Duration	Colour	Smell	Amount	Nature	Agg fac	Rel.fac	trearment
Right								
Light								

Hard of hearing:

	Onset	Duration
Right		
Left		

Earache:

Vertigo:

Tinnitus:

Nasal complaints:

Discharge	Obstruction	Smell	Smell	PND

Throat complaints:

Past history:

Medical:

-H/o allergy

-H/O exposure to noise pollution

Surgical :

Ear surgery.

Skull

Family h/o:

General examination:

Anaemia	Jaundice	Cyanosis	Clubbing	Pedal edema	GLNE

Vitals:

Examinations of ear:

External ear:

	Pinna	Preauricule	Post auricule	EAC
Right				
Left				

Tympanic membrance:

	Retraction	Perforation	Granulation	Discharge	Chol.flakes
Right					
Light					
site					

	Ossicles	Colour of TM	T.Selerosis
Right			
Left			

Tuning fork test:

	right	left
Rinne 256 512 1024		
Weber		
ABC		

Fistula test:

Valsalva maneovour:

Nose

	External	Septum	Turbinate	Meatus	mucosa
Right nostril					
Left nostril					

Throat:

Oral cavity:

Oropharynx:

Investigations:

CBC,RFT,Grouping typing ,Urine routine.

HIV,Hep-B:

CXR,ECG.

PTA:

X-RAY Mastoid:

OTO-Endoscopy:

SURGERY

Procedure: Dos:

Anaesthesia:

Approach:

EOT findings:

TM:

Middle ear mucosa:

Ossicles: 1. Handle of Malleus

2. Long process of incus

3 .Lenticular process IS Joint

ATTIC Cholesteatoma:

TENSOR retraction:

SINUS TYMPANI retraction:

Canaloplasty done : Yes/no

Middle ear mucosa biopsy : Yes/no

Contents:

Ant.canal wall hump:

Glue +/-:

Tympanosclerosis:

Otosclerosis:

Mastoid:

Pneumatised/sclerosed/glue

Antral mucosa:

Aditus:

Patent/body of incus seen.

Gel foam: +/-

Facial canal dehiscence: +/-

Others: complications:

Follow up:

period	Middle ear aeration	Soft wall status	Post-op A-B gap
1month			
2 month			
6month			
1year			

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Sl. No.	Nam	Age/ Sex	Discharge (yrs)		HOH (yrs)		EAC	TM		Xray mastoid		PTA			Side	EXT	AP PR.	Ana.	MM	OS	CC	Healing time	SX	POP SW 1y	PO PTA dB gain
			R	L	R	L		R	L	R	L	AC	BC	A-B								days			
1	NA	28/F		2y		6m	G1		PSR	P	S	45	20	25	L	Md	Tc	GA	P+G+	I-M+S-	-	20	Cwd/at	N	10
2	YA	36/f		20y		15y	G1		AP	S	S	50	15	35	L	E	Tc	GA	P+G+	I-M-S+	-	24	Cwd/at	N	10
3	IM	18/f	ch		2y		G2	PSR	-	S	S	55	20	35	R	E	Tc	LA	GR	I-M+S-	I	36	Cwd/at	P	15
4	PR	32/m	ch	Ch	20y	15y	G2	PSR CP+	PSR	C	C	60	20	40	R	E	Pa	LA	P+ G+	I-M+S-	I	25	Cwd	C	25
5	DH	17/m	-	2y	-	-	G1		AP	P	S	40	15	25	L	E	Tc	LA	P+G+	I-M+S-	-	21	Cwd/at	C	20
6	VI	11/m	-	1y	-	6m	G1		PSR CP+	P	S	45	15	30	L	E	Tc	GA	P+ G+	I-M+S-	-	28	Mrg/at	P	15
7	SU	30/m	-	-	6m	-	G2	PSR		S	P	40	15	25	R	Md	Tc	LA	H	I-M+S+	CS	27	Mrg/at	N	10
8	LS	19/f	ch	2y	6y	1y	G3	AP	CP+	S	S	35	10	25	R	E	Tc	LA	P +G+	I-M+S-	-	19	Cwd /at	N	10
9	SH	12/m	1y	-	6m	-	GI	AP		P	P	40	15	25	R	M	Tc	GA	H	I-M+S+	-	23	Atti/at	N	15
10	SU	26/f	-	Ch	-	5y	G2		AP	P	S	55	30	25	L	E	Tc	LA	H	I-M-S+	CS	28	Cwd/at	P	10
11	VK	28/m	1y	6m	-	-	G1	PSR	CP	P	P	40	10	35	R	E	Pa	LA	GR G+	I-M-S+	-	26	Cwd	N	10
12	AN	23/f	-	-	6m	-	G2	PSR		P	P	60	25	35	R	MD	Tc	LA	H	I-M-S+	-	25	Mrg/at	N	10
13	DN	25/m	8y		1y	-	G1	PSR		S	P	55	20	35	R	E	Tc	LA	H	I-M+S-	-	29	Cwd/at	N	10
14	VM	28/f	-	Ch	-	5y	G3		PSR	S	S	50	25	25	L	E	Tc	LA	P+G+	I-M+S-	-	37	Cwd/at	C	25
15	JH	25/m	-	3y	-	3y	G1		PSR	S	S	50	20	30	L	Md	Tc	LA	P+G+	I-M+S-	-	26	Cwd/at	N	15
16	LK	28/f	3y		-	-	G1	PSR		S	P	45	10	35	R	MD	Tc	LA	GR+G	I-M+S-	-	34	Cwd/at	N	15
17	SU	31/f	1y	Ch		5y	G2	PSR	PSR	S	S	50	25	25	L	E	Tc	LA	P+G+	I-M-S-	-	36	Cwd/at	P	15
18	MR	24/f	-	-	6m	-	G3	PSR		P	P	55	30	25	R	E	Tc	GA	GR+G	I-M+S-	I	28	Cwd/at	N	10

19	JY	20/f	7y	-	2y	-	G1	AP		S	P	40	10	30	R	M	Tc	LA	H	I-M+S+	-	27	Atti/at	N	10
20	SN	24/m	-	Ch	-	10y	G2		PSR	S	S	65	25	40	L	E	Tc	LA	GR	I-M-S-	-	26	Cwd/at	P	25
21	SR	35/f	3y	1y	3y		G1	PSR	AP	P	P	45	15	20	R	E	Tc	GA	P+G+	I-M+S-	-	22	Cwd/at	N	15
22	DI	31/m		6y	1y		G2		PSR	P	S	40	10	30	L	MD	Tc	LA	H	I-M+S+	-	28	Cwd/at	P	15
23	RH	18/m	ch	Ch	10y	10y	G1	AP	PSR	C	C	40	15	25	L	E	Tc	GA	P+	I-M+S-	-	25	Cwd/at	N	25
24	KO	25/f	1y		-		G3	PSR		S	P	65	25	40	R	E	Tc	LA	GR+G	I-M-S-	CS	24	Mrg/at	N	15
25	MU	16/f		1y		1y	G2		AP	P	P	55	30	25	L	E	Tc	GA	GR+G	I-M+S-	-	26	Cwd/at	C	25
26	TH	38/f	15y				G1	AP		S	P	70	30	40	R	M	Tc	LA	H	I-M+S-	I	28	Atti/at	C	20
27	SI	36/m		2y		2y	G1		AP	P	P	40	15	25	L	M	Tc	LA	P+G+	I-M+S-	-	26	Cwd/at	P	10
28	ML	40/f	2y	12y			G2	AP	PSR	S	S	60	35	25	L	MD	Tc	LA	GR+	I-M+S+	I	29	Cwd/at	N	10
29	SR	27/m		6y	6m	5y	G1		PSR	P	S	55	20	35	L	M	Tc	LA	H	I-M+S+	-	27	Cwd/at	P	10
30	VI	22/m	2y	Ch	2y	5y	G1	PSR	PSR	S	S	65	35	30	L	E	Tc	LA	P+G+	I-M-S-	-	35	Cwd/at	C	25
31	PR	19/f			1y		G1		PSR	P	P	45	20	25	R	E	Tc	GA	P+G	I-M+S+	-	32	Marg /at	P	15
32	SE	35/f		15y		3y	G3		AP	S	S	45	15	30	L	M	Tc	LA	H	I-M+S+	I	26	Atti/at	N	10
33	RA	28/m	7y		1y		G3	AP		S	P	60	25	35	R	M	Tc	GA	P+	I-M+S+	CS	31	Cwd/at	N	20
34	RA	18/m	6m	2y			G2		AP	P	P	55	25	35	L	E	Tc	GA	P+G+	I-M-S-	-	29	Cwd /at	P	15
35	PRI	19/m		Ch		2y	G1		PSR	S	S	55	15	40	L	MD	Tc	LA	P+G+	I-M+S+		27	Marg /at	N	15