PROSPECTIVE OBSERVATIONAL STUDY OF OTOLOGICAL TRAUMA

By

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Dissertation submitted to the

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION TAMAKA KOLAR

In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY IN OTORHINOLARYNGOLOGY

Under the guidance of

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SRI DEVARAJ URS MEDICAL COLLEGE

TAMAKA, KOLAR

2015

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ACKNOWLEDGEMENT

My teacher and guide, ***Dr. Khaja Naseeruddin, MBBS, MS*** Professor and former Head of Department of Otorhinolaryngology, Sri Devaraj Urs Medical College Tamaka, Kolar, walked along with me – supporting, advising,providing insights,giving me glimpses of new paths – not only for my dissertation – related work but also throughout my continuing post graduate journey. To him goes my heartfelt thanks offered with reverence and respect.

Dr. Khaja Naseeruddin, MBBS, MS Professor and Head of Department of Otorhinilaryngology, Sri Devaraj Urs Medical College Tamaka, Kolar, provided encouragement, ensuring absence of any hurdles in carrying out my work in the department as also my dissertation work. I am grateful to you sir.

I would like to express my gratitude to *Dr. Sagaya Raj .A., Dr. Chandrakala* – Associate Professors, *Dr. Shuaib Merchant, Dr. Nikhil* – Assistant Professors, *Dr. Vishal, Dr. Kauser, Dr. Divya, Dr. Sindura* – Senior residents, of Department of Otorhinolaryngology for their ready support, guidance and constant encouragement in the preparation of this dissertation and throught my post graduate course.

I would like to convey my gratitude to *Dr. MAHESH* Department of Preventive and Social Medicine, Sri Devaraj Urs Medical College Tamaka, Kolar, for his help and support for providing a tangible to the data in my work.

I would like to convey my heartfelt thanks to the former staff of Department of Otorhinolaryngology – *Dr. G.K. Narayan, Dr. Thomas Prasannaraj, Dr.Vinay Babu, Dr. Shiv Prakash,, Dr. Venkatesh* for their advice and encouragement.

I am immensely thankful to all my PG colleagues, seniors and juniors ,my parents ,patients and their relatives.

My immence gratitude and special thanks to my parents and friends for their constant encouragement, support and love.

This dissertation endeavour involved 50 patients and indirectly their family members. To these stoic people who showed great strength despite their suffering, let me say, I am greatly indebted…thank you and….Godbless.

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LIST OF ABBREVIATIONS

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BPPV Benign Paroxysmal Vertigo

CSF Cerebrospinal fluid

EAC External auditory canal

CT Computerised tomography

ABSTRACT

AIMS AND OBJECTIVES

1. To study the clinical presentation ,course,management and outcomes of otological trauma

2. To correlate complications(chondritis,hearing loss,facial nerve palsy) with otological trauma

METHOD

A prospective study of 51 cases of otological injuries from November 2012- June 2014 were included in the study . Pinna injuries were managed with antibiotics and by meticulous surgical techniques.Traumatic tympanic membrane perforations with persistant perforations were managed surgically by Type 1 tympanoplasty (underlay technique) .Facial Nerve Palsy were delayed onset type and was managed by systemic steroids .The outcomes measured were that of chondritis and deformity associated with pinna injuries,hearing in traumatic tympanic membrane perforations ,facial nerve and hearing results after a period of 3 months .

RESULTS

Assaults and road traffic accidents were the most common cause ,alcohol consumption was contributing to both .Out of the 51 otological injuries ,around 32(60%) had pinna injuries,17 had traumatic tympanic membrane perforations ,15 had temporal bone fractures . 2 patients had chondritis and 1 patient had pinna deformity .

Assault was the most common cause of traumatic tympanic membrane perforation .All 7 cases underwent a Type 1 tympanoplasty ,underlay technique and the average period of healing was 21 days on an average .

Majority of temporal bone fractures were due to RTA (alcohol influence) .Ear bleeding was seen in 73.3%,Hearing loss 20%,CSF otorrhoea and vertigo in around 6%.

Facial Palsy was seen in 4 patients .3 had delayed onset of facial nerve palsy and were treated by medical line of management and physiotherapy.

CONCLUSION

Timely surgical intervention helps in minimizing disfigurement due to perichondritis.Persistant perforations of tympanic membrane treated by surgical line of management helps faster healing of management .Preventable measures like use of helmets helps in preventing injuries to external and inner ear.Enforcement of strict traffic rules helps in reducing injuries.

KEYWORDS:

Chondritis ;Traumatic Tympanic Membrane;Temporal Bone Fracture;

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INTRODUCTION

Trauma has become a major cause of morbidity and mortality especially in today's highly mechanised world.Management of otological trauma poses a challenge to the otorhinolaryngologists in terms of both the complications and sequelae.

Road traffic accidents due to motor vehicle accidents and assaults are the most commonest cause of External auditory canal injuries ,temporal bone fractures , facial paralysis hearing loss thereby making the patient handicap

Therefore knowing the anatomy and physiology of the ear is essential for interpreting the signs and symptoms and also for the management

Our study is undertaken at SRI DEVERAJ URS MEDICAL COLLEGE KOLAR to know the salient features of clinical presentation and management of otological injuries .

Pinna injuries leads to hematoma and perichondritis.Pinna injuries should treated promptly to prevent the risk of deformity as perichondritis and deformity is more dangerous than the trauma itself as per a study done by K Sharma et al 2006 and Davidi et al [1,2]

Stacey L. Ishman,; David R. Friedland 2004 showed in their study that 70-90% are longitudinal fractures and 10-30% are transverse fractures.[3]

Degree of otological injuries could be mild to severe.It also depends on the impact of accident and also on direction of blow.Ear bleeding (EAC bleed) ,tympanic mebrane ruptures ,hearing loss ,facial nerve injury , CSF leak and vertigo .

Appropriate clinical examination , otomicroscopy , radiological investigations like CT scans , pure tone audiometry to assess the degree of hearing loss have changed the protocols in management of ear injuries .

Henceforth we are undertaking a study to assess various manifestations following ontological injuries and also the importance of an otolaryngologist in their approach to ear injuries

OBJECTIVE

1)To find out the incidence of otological trauma

2)To study the morbidity and mortality of otological trauma

3) To study the outcom of management of otological trauma .

REVIEW OF LITERATURE

KS Sharma et al[1] in their study showed that auricular trauma should be treated promptly as it carries risk of added deformity due to perichondritis and deformity due to same is more dangerous than trauma itself

Goal of treatment of external ear injures is to restore the normal contour and prevent infections.Chondritis is the most feared complication and requires removal of pus and necrotic cartilage ,with administration of antibiotics,as per a study done by Jery Templer,Gregory J, Renner.[2]

Backous et al[3] (1996) in their study that external auditory canal trauma ranged from impaction of foreign body to severly comminuted temporal bone sustained after blunt or penetrating trauma .

Ghoyareb et al[4](1987) in their study done at University of Texas Health Science Centre (1982-86) showed in around 82 temporal bone fractures 15% longitudinal and 13% transverse fracture .60% had facial paralysis ,20% conductive hearing loss 14% had sensorineural hearing loss and mixed 55%

Study done on 30 cases of temporal bone fractures by Grewal DS et al[5] (1998) showed that 25 cases had longitudinal temporal bone fractures ,4 transverse , 1 was mixed , ear bleeding was present in 20 cases conductive hearing loss was seen in 19 cases , remaining had sensorineural hearing loss.Tympanic membrane is involved more commonly on longitudinal fractures.Facial nerve palsy immediate onset was seen in 10 , 9 underwent surgical intervention and 4 recovered completely

Meriot P ,Vellon F et al[6](1997) showed in their study that ossicular chain was a frequent complication in temporal bone injury.Skull trauma is the main cause of ossicular injury.This resulted in ossicular dislocation. HRCT is the main imaging modality

Incudostapedial joint was most commonly affected joint as per a study done Wang LF ,HO-Ky et al[7](1999) .

A study done by Hemanth Chopra et al[8] on 500 patients on facial nerve paralysis . 21 (43.7%) patients had delayed onset of facial paralysis , 13 (27.1%) had immediate onset 14(29%) could not be assessed .On high resolution CT ,19 patients had longitudinal fractures ,transverse in 19 patients and 11 had comminuted type .

Darrouzet et al[9] in their study of management on facial nerve palsy resulting from temporal bone fracture in 115 cases showed electrodiagnostic tests determine the prognosis of facial nerve paralysis .

Karnik P et al[10] in their study showed that guidelines for treatment in facial nerve injury are time of onset ,electrical response,and other damages like CSF otorrhoea or ossicular disruption and cholesteatoma.In this study mastoidectomy was done for one patient for associated cholesteatoma and surgery was done for CSF otorrhoea.

ANATOMY OF EAR

Ear is the most important organ for hearing and equilibrium .It also adds to the appearance and the personality of an individual .It is considered under three headings

External Ear :adding to the external appearance

Middle Ear: Conducting apparatus to sound

Inner Ear: Peripheral sensory organ for hearing and equilibrium

EXTERNAL EAR

External ear is formed by the auricle, external auditory canal and the tympanic membrane .

AURICLE [11,12]

Auricle (FIGURE 1) projects at an angle from the side of the head and adds to external appearance and also collects sound.

It is made of an yellow fibroelastic cartilage covered by thin skin that is adherent to the perichondrium .It is attached to the skull by continuation of its cartilage as the cartilaginous part of external auditory canal and also anterior and posterior ligaments and three extrinsic muscles. There are six inconsistent ill-defined intrinsic muscles and ligaments.

Lateral surface of auricle has many prominences and depressions with the concavity facing forwards and laterally

Helix is a curved rim .It has small tubercle in the posterior-superior aspect known as Darwin's tubercle and anterior limb descends to form the crus of helix .Antihelix is another prominence lying anterior and parallel to helix. It divides superiorly into two crura, the triangular fossa and scaphoid fossa below.

Concha lies between antihelix and crura, region covering the crus is called cymba concha that corresponds to the suprameatal triangle

Below the crus of helix and in front of external auditory canal lies the triangular prominence, tragus. Opposite to it and inferior limit of antihelix is the antitragus

Lobule lies below the antitragus and is skin covered flap containing fibrocartilage and devoid of cartilage.

Medial surface contains elevations that correspond to depressions of lateral surface like eminentia conchae etc.

VASCULAR SUPPLY:

Blood supply is by the posterior auricular artery, anterior auricular branch of superficial temporal artery and the auricular branch of occipital artery

NERVE SUPPLY:

Greater auricular nerve, lesser occipital, auricular temporal nerve and auricular branch of vagus

LYMPHATIC DRAINAGE:

Nodes at mastoid tip ,preauricular nodes and deep cervical nodes

FIGURE 1:Auricle

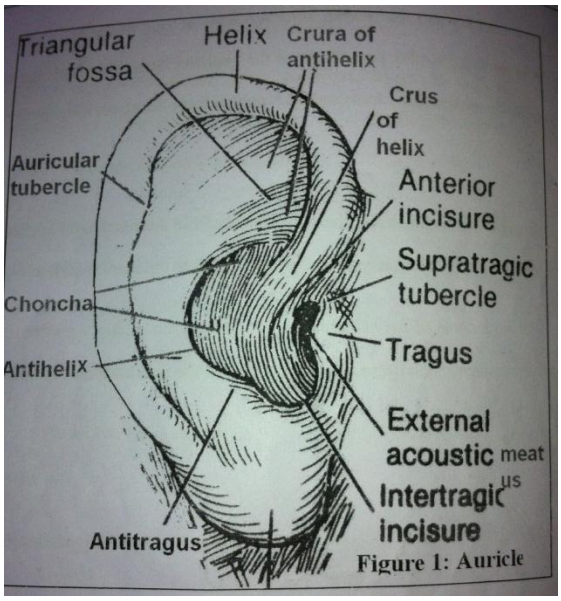


Figure 1: Auricle

EXTERNAL AUDITORY CANAL [11, 12, 13]

Extends from concha to tympanic membrane and is an S shaped and has three parts .Pars externa, Pars intermedia and Pars interna.

Pars externa -directed upwards ,forwards and medially

Pars intermedia -directed upwards ,backwards and medially

Pars interna- directed downward,forwards and medially

Lateral One third of the cartilaginous part forms around 8 mm is continuous with the auricular cartilage and is deficient superiorly.The medial border of meatal cartilage is attached to rim of bony canal by fibrous band .Two or three perforations in the anterior aspect form the fissures of santorini

The Bony meatal part (16mm) is composed of tympanic bone anteriorly ,inferiorly and part of posteriorly and remaining by the squamous part .

Medially ends at annular sulcus and deficient superiorly ,notch of rivinus

Two constrictions ,one near at the junction of cartilaginous and bony portions

Isthmus which lies 5 mm lateral to tympanic membrane and is the narrowest part

Skin of cartilaginous part is adherent and is thicker containing hair follicles ,sebaceous glands and ceruminous glands .

Skin of the bony part is thin and lacks hairs or glands

VASCULAR SUPPLY

ANTERIORLY: auriculo- temporal branch of superficial temporal artery and deep auricular branch of maxillary artery

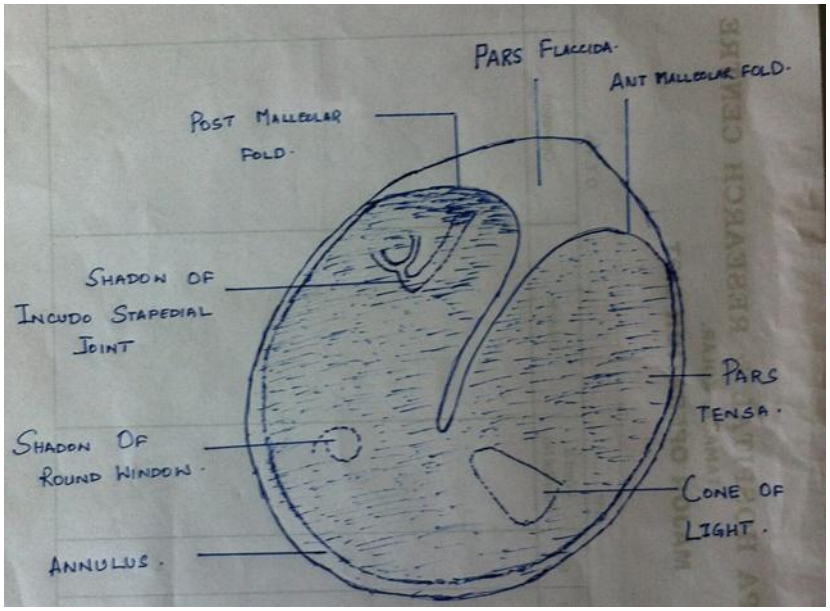
POSTERIORLY: posterior auricular branch of external carotid artery

NERVE SUPPLY:

Auriculotemporal nerve and Arnolds (auricular branch of vagus)

TYMPANIC MEMBRANE[11,12]

FIGURE 2 :TYMPANIC MEMBRANE .



Thin,oval and pearly grey white trilaminar membrane that seperates the tympanic cavity from the external ear

Longest diameter is from the posterior-superior to anterior inferior -9-10mm

Perpendicular is the shortest diameter around 8-9mm.Tympanic membrane is placed obliquely at an angle of 55degree with the floor of meatus

Circumference of tympanic membrane is thickened to form the fibrocartilaginous ring ,the annulus which sits in the sulcus of tympanic

bone .Near the superior limits of sulcus ,the annulus becomes fibrous bands which run centrally as anterior and posterior malleolar folds to the lateral process of malleus ,dividing the tympanic membrane into pars tensa and pars flaccida

Pars tensa is the part below the malleolar folds which contains handle of malleus in it and intermediate radiating fibres that makes taut .

From the external auditory canal it appears concave with maximum depression at the inferior tip of malleus handle known as umbo .

Every portion of membrane that runs from the umbo to annulus is gently convex to middle ear

PARS FLACCIDA

Small triangular portion above malleolar folds which does not contain tympanic annulus and is lax

LAYERS OF TYMPANIC MEMBRANE

Three layers form the tympanic membrane

OUTER EPITHELIAL LAYER ,MIDDLE FIBROUS LAYER,LAMINA PROPRIA AND INNER MUCOSAL LAYER

Outer epithelial layer is continuous with the skin of external auditory canal and has six layers of skin as other parts of body ,without rete pegs

The lamina propria contains collagen fibres in the pars tensa and pars flaccida.

Arrangement of fibres in pars tensa ,lateral most fibres are radial while the deeper ones are circular ,parabolic and transverse

A layer of loose connective tissue lies between the deep layers of lamina propria and inner mucosal layer .

In the PARS FLACCIDA - lamina propria is less marked and collagen fibres lie in random orientation

INNER MUCOSAL LAYER is a simple squamous or cuboidal to pseudostratified columnar epithelium ,separated from lamina propria by a basement membrane

Tympanic membrane is divided into four quadrants for description by an imaginary line passing across the long axis of handle of malleus and another line perpendicular to this passing through the umbo

The four quadrants are

1) Antero superior
2) Antero inferior
3) Posterior superior
4) Posterior inferior

Blood supply is by branches supplying the external auditory canal and middle ear .The vessels lie in the connective tissue layer of lamina propria .

Blood supply

Deep auricular branch of maxillary artery from external auditory canal and middle ear

Anterior tympanic branch of maxillary

Branches from stylomastoid branch of posterior auricular artery

Branches from middle meningeal artery

VENOUS DRAINAGE

Mainly to external jugular vein ,transverse sinus ,dural veins and the venous plexus around Eustachian tube

NERVE SUPPLY

Auriculotemporal nerve anteriorly

Auricular branch of vagus posteriorly

Tympanic branch of glosssopharyngeal (jacobsons nerve)supplying the inner mucosal layer

Middle ear cleft [11,12,13]

Consists of tympanic cavity , Eustachian tube ,and the mastoid air cell system

The Tympanic cavity

An air filled space within the temporal bone and contains the ossicles, with the muscles.Tympanic cavity appears as a box which has four walls ,a roof and a floor which

measures 15 mm in height ,13 mm anteroposteriorly and the narrowest being the transverse diameter 2mm in the centre

THREE PARTS OF TYMPANIC CAVITY

Epitymapanum (Attic) –lies above the tympanic membrane ,and contains the head of malleus and the body and short process of incus

Mesotympanum –lies the opposite the tympanic membrane ,handle of malleus the long process of incus and stapes

Hypotympanum – lying below the tympanic membrane

LATERAL WALL[12]

Central portion is formed by the tympanic membrane ,above and below is a bone which forms the outer lateral walls of epitympanum and hypotympanum .Pars flaccida also lies in the lateral wall . The bony portion is outer attic wall or scutum,which forms the superior portion of deep part external auditory meatus

Three openings are present in the bone of medial surface of lateral wall

1) Opening of posterior canaliculus for chorda tympani nerve at the angle between lateral and posterior wall of tympanic cavity ,at the upper level of handle of malleus
2) Branch of stylomastoid artery also accompanies the nerve
3) Chorda tympani lies anterior and lateral to the facial nerve at the opening

Petrotympanic(glaseerian fissure) opens anteriorly above the tympanic membrane. 2mm long slit which receives the anterior malleolar ligament and also transmits the anterior tympanic branch of maxillary artery to tympanic cavity .The chorda tympani nerve enters medial surface of fissure through a separate anterior canaliculus ,the canal of Huguier

ROOF[12,14]

Formed by the tegmen tympani and seperates the tympanic cavity from the dura ,also formed partly by the petrous bone ,the squamous bone and the suture lines that transmits the veins from the tympanic cavity to the superior petrosal sinus .Cog ,bony crest descending from tegmen divides the epitympanum into posterior attic and anterior epitympanic sinus

FLOOR [12,14]

It is narrower and consists of thin plate of bone separating from the dome of jugular bulb . A small opening at the junction of floor and medial wall enters the tympanic branch of glossopharyngeal nerve

ANTERIOR WALL[12,14]

Narrow wall . Lower portion is larger and contains a thin plate of bone covering the carotid artery .This plate of bone is perforated by superior and inferior caroticotympanic nerves which carry sympathetic fibres to tympanic plexus and the tympanic branch of internal carotid artery

The upper part has two tunnels placed one above the other ,lower opening leading to eustachian tube ,upper tunnel contains the tensor tympani muscle

MEDIAL WALL[12]

Seperates the tympanic cavity from inner ear . It has prominent features and two openings .The promontory is the rounded elevation which occupies most of the central portion of medial wall .It has the small grooves on the surface for nerves forming tympanic plexus . Sometimes these grooves containing the tympanic branch of glossopharyngeal nerve may be covered by bone, forming small canals .

Posterio –superior to promontory lies the fenestrae vestibule (oval window) , a kidney shaped opening which connects the tympanic cavity with the vestibule ,but in life is closed by the foot plate of stapes and the annular ligaments . Size of fenestrae varies , on an average 3.25 mm long and 1.25 mm wide . it lies at the bottom of a depression that can be varying depending on the position of facial nerve above and the prominence of promontory below.

The fenestrae cochlea (round window) is closed by the secondary tympanic membrane (round window membrane) lies below and behind the oval window ,from which it is separated by a posterior extension of promontory the subiculum

Ponticulus (spicule of bone) leaves the promontory above the subiculum and runs to the pyramid on the posterior wall of cavity.Fenestrae cochleae which faces inferiorly and little posteriorly ,lies completely under the cover of overhanging edge of promontory in a deep niche and is out of sight . The niche is in triangular shape with anterior,posterior-superior ,postero-inferior walls . Later two walls meet posteriorly and lead to sinus tympani .Secondary tympanic membrane lies almost horizontally in the roof of niche and curves towards the sinus tympani of basal cochlea . The shape of membrane varies fro, round through oval ,kidney shaped to spatulate wit average longest and shortest diameters of 2.3 mm and 1.87 mm respectively

The round window membrane has three layers :outer mucosal ,middle fibrous and inner mesothelial layer .this membrane forms a part of floor of sinus tympani . The scala tympani terminates posterior and medial to membrane

The facial nerve canal lies above the promontory and fenestrae vestibuli in an anterior posterior direction .It has smooth rounded lateral surface .anteriorly marked by the processus cochleariformis ,curved projection of bone, has the tendon of tensor tympani muscle as it turns laterally to the handle of malleus .Behind the fenestra vestibule facial canal starts to turn inferiorly

The region above the facial nerve canal forms the medial wall of epitympanum . Dome of lateral semicircular canal is the major feature in posterior portion

POSTERIOR WALL [12,14]

Posterior wall is wider above than below and in its upper part has the opening (aditus) into mastoid antrum . Its an irregular hole which leads back from the posterior epitympanum .Below the aditus is a small depression ,fossa incudis which has the short process of incus and ligaments connecting the two

PYRAMID – another landmark which lies below the fossa incudis and lies medial to opening of chorda tympani . It's a conical projection and its apex points anteriorly .It contains stapedius muscle and its tendon passes forwards anteriorly to get inserted into neck of malleus

FACIAL RECESS – lies between pyramid and tympanic annulus and is bounded medially by the facial nerve and laterally by annulus ,chorda tympani runs obliquely in the recess .

Deep to the pyramid and facial nerve lies the posterior extension of mesotympanum the sinus tympani

CONTENTS OF TYMPANIC CAVITY [12]

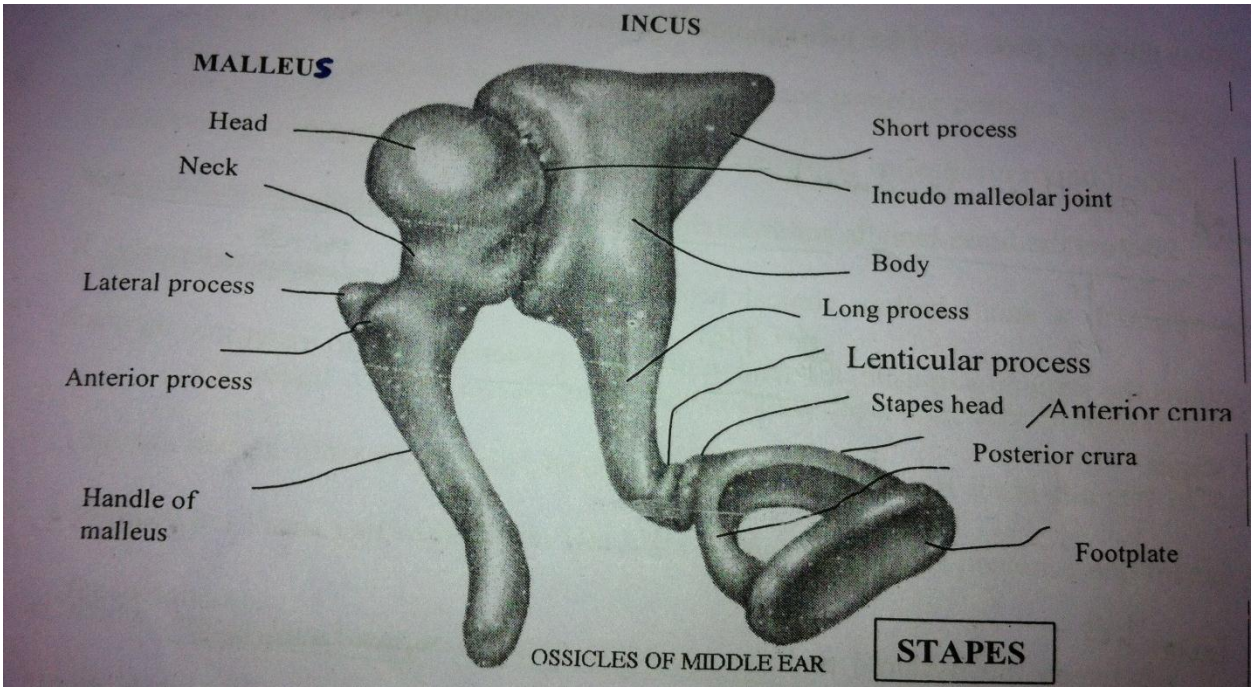


FIGURE 3:Ossicular chain

The contents are mainly small mobile bones – malleus ,incus and the stapes

Two muscles – tensor tympani and the stapedius ,chorda tympani nerve,and the tympanic plexus of nerve

MALLEUS [12]

Hammer shaped bone and the largest comprises of head ,neck and three process which arises below the neck .The length is around 7.5mm-9mm .

The head lies within the epitympanum and on its posteromedial surface is an elongated saddle shaped cartilage covering facet for its articulation into the incus .In the middle this surface is constricted and small inferior portion lies at right to superior portion .the projecting lower part is the cog or spur of malleus

Bone broadens below the neck and gives rise to anterior process which gives rise to the anterior ligament to insert into the petrotympanic fissure ; lateral process that receives the anterior and posterior malleolar folds and the handle

The handle runs downwards medially and slightly behind between the fibrous and the mucosal layers of tympanic membrane . There is a small projection for tensor tympani , in the deep medial surface of handle in its upper end .

INCUS[12]

Has a body and two processes .body lies within the epitympanum and has a cartilaginous facet which corresponds with malleus . short process projects backwards and lies within the fossa incudes and is attached by a short ligament . The long process descends behind and medial to handle of malleus into mesotympanum .Lenticular process is medially directed and articulates with head of malleus

STAPES[12]

PARTS OF STAPES : Head ,neck , two crura , base or foot plate . Head is directed laterally and has a small cartilage covered depression for articulation with lenticular process of incus . Tendon of stapedius inserts into posterior part of neck and upper part of posterior crus . From the lower

broader part arise two crura . Anterior crura is thinner and less curved than posterior one .Both the crura hollow out on concave surfaces

Crura join the footplate , having a convex superior margin and a straight inferior margin and a curved anterior and posterior ends . It lies within fenestrae vestibule and attached to it by annular ligament

STAPEDIUS MUSCLE[14]

Arises from the walls of conical cavity within the pyramid and from the downward continuation of this canal in front of the descending portion of facial nerve . nerve supply is branch of facial nerve

TENSOR TYMPANI MUSCLE[12]

Long slender muscle arising from the walls of bony canal lying above the Eustachian tube . Muscle also arises partly from the cartilaginous eustachian tube and greater wing of sphenoid .The muscle runs backwards into tympanic cavity ,lying on medial wall ,enters processus cochleariformis where it is held by a transvers tendon ,then turns to right angle to insert to medial aspect of upper end of malleus handle . It supplied by the mandibular nerve through the medial pterygoid nerve.

CHORDA TYMPANI NERVE[12]

A branch of facial nerve enters the tympanic cavity from the posterior canaliculus and runs across the medial surface of tympanic in between mucosal and fibrous layers and the passes medial to upper portion of handle of malleus and leaves by anterior canaliculus ,then joins the petrotympanic fissure

TYMPANIC PLEXUS[12]

Formed by the tympanic branch of glossopharyngeal nerve and caroticotympanic nerves from sympathetic plexus around the internal carotid artery .It lies on promontory and supplies the following:

1) branches to mucus membrane lining the tympanic cavity ,Eustachian tube and mastoid antrum and air cells
2) Branch which joins the greater petrosal nerve
3) Lesser petrosal nerve containing the parasympathetic fibres of glossopharyngeal nerve

MUCOSA OF TYMPANIC CAVITY[12]

It is a respiratory mucosa to some degree carrying cilia and secretes mucus .Goblets cells and mucus producing cells linked to surface by short ducts produce the mucus . These are clustered around ET tube opening

The mucus membrane lining bony walls of tympanic cavity cover the ossicles and their supporting ligaments,also covers the tendons of two intratympanic muscles and carries blood supply to and from the content of tympanic cavity

BLOOD SUPPLY OF TYMPANIC CAVITY[12]

Interior tympanic artery branch of maxillary artery supplies the tympanic membrane ,malleus and incus ,anterior part of tympanic cavity . stylomastoid artery ,a branch of posterior auricular artery supplies posterior part of tympanic cavity and stapedius muscle .Mastoid artery a branch of stylomastoid supplies mastoid air cells .Petrosal branch of middle meningeal artery supplies mastoid roof and epitympanum roof .

Superior tympanic branch of middle meningeal artery supplies malleus and incus ,tensor tympani muscle Inferior tympanic branch of ascending pharyngeal artery ,tympanic branch of internal carotid artery .Branch from artery of pterygoid canal supplies meso and hypotympanum

EUSTACHIAN TUBE[12]

It is a tube connecting tympanic cavity and nasopharynx .

Length is 36mm runs downwards ,forwards and medially from middle ear . It consists lateral bony portion from anterior wall of tympanic cavity and medial fibrocartilagnous part entering nasopharynx .Lining is by respiratory mucosa containing goblet cells and has ciliated epithelium on its floor

Bony portion is 12mm long is widest at its tympanic end.It passes through squamous and petrous portion and gradually narrows to isthmus which is the narrowest part where diameter is 2mm or less .The carotid artery lies medial to the tube

The medial two third (24mm) cartilaginous part has a plate of cartilage in the posteromedial wall and upper border and ahsort flange anteriorly .The rest is formed by fibrous tissue .The medial end which is wider lies directly under the mucosa of nasopharynx and forms tubal elevation .This part is fixed to base of skull in a groove between petrous part of temporal bone and greater wing of sphenoid

ADITUS AD ANTRUM[12]

Large irregular opening from the posterior epitympanum into air filled spaces of mastoid antrum also referred to aditus ad antrum . Medial wall is formed by the prominence of lateral semicircular canal.Bony canal of facial nerve lies just below and medial .The short process of incus is closely related to the two structures .the average distance ranges between facial nerve and and semicircular nerve – 1.77m ;facial nerve –short process of incus -2.36mm ; and short process of incus to semicircular canal – 1.25mm

MASTOID ANTRUM[12]

An air filled sinus lying within the petrous part of temporal bone . The average volume is around 1ml front to back it measures 14mm :top to bottom 9mm ,7mm side to side .

RELATIONS

MEDIAL WALL – related to posterior semicircular canal

DEEPLY AND INFERIORLY – endolymphatic sac and dura of posterior cranial fossa .

ROOF – part of floor of middle cranial fossa separating antrum from the temporal lobe of brain

LATERAL WALL – part of squamous temporal bone and is about 12-15 mm thick in adults . This wall corresponds to the suprameatal triangle (McEwans triangle)on the outer surface of skull

FLOOR – digastric muscle laterally and sigmoid sinus medially .

ANTERIOR WALL- Aditus superiorly ,facial nerve passes in its descent ,lower down

MASTOID AIR CELL SYSTEM [12,15]

A more or less extensive system of interconnecting air filled cavities arising from walls of mastoid antrum . They extend throughout mastoid process and may be separated by thin plate from sigmoid sinus posteriorly and from posterior and middle cranial fossa superiorly (tegmenmastodei and tegmenantri).Cells may extend medially as retrofacial cells ,down as tip cells , and reach angle between sigmoid sinus and tegmen (sinodural angle) and also to root of zygoma .The apex of petrous bone is pneumatised occasionally

Pneumatization can be extensive ,then its called well pneumatized or cellular mastoid .

Can be only air filled spaces – acellular or sclerotic mastoid

Between above two forms – diploeic or mixed –air cells are present and are interspersed with marrow containing spaces that have persisted from the late fetal life

INNER EAR[12]

Inner ear or labyrinth which lies in the temporal bone consists of bony labyrinth and a membranous labyrinth which lies within bony labyrinth

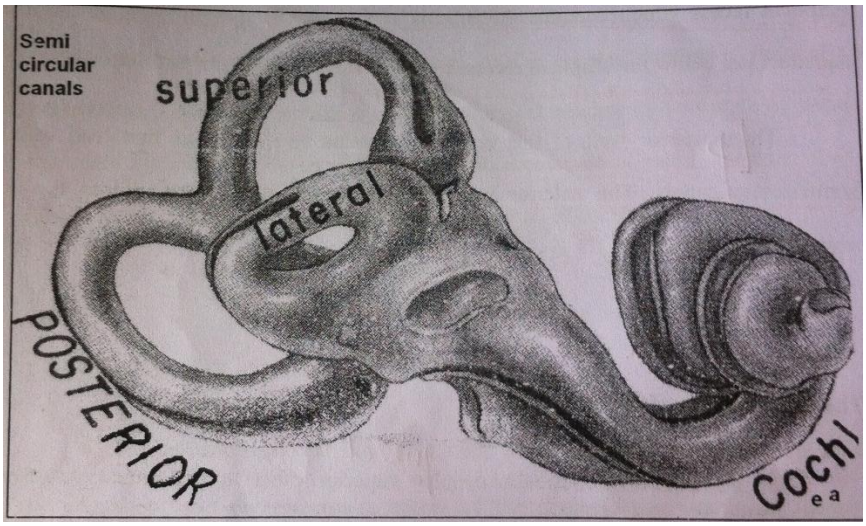


FIGURE 4 : THE BONY LABYRINTH.

BONY LABYRINTH (Fig 4)

Consists of thin , dense bony shell surrounding vestibule ,semicircular canal amd cochlea

VESTIBULE[12.]

Central portion of labyrinth which lies between the middle ear and fundus of internal auditory meatus .Lateral wall consists of oval window . On the medial wall anteriorly lies the spherical recess which has the macula of saccule and is perforated by small holes for the inferior vestibular nerve. Behind this lies the vestibular crest ,and its lower end divides to encompass the cochlear recess carrying cochlear nerve fibres to the base of cochlea .Elliptical recess lies above and behind the crest and contains maculae of utricle . The opening of vestibular aqueduct lies below and carries the endolymphatic duct .

Posterior wall of vestibule contains five openings which lead into semicircular canal .Anterior wall has an elliptical opening into scala vestibule of cochlea .

SEMICIRCULAR CANAL[12]

There are three semicircular canals which are superior ,posterior and lateral .Each canal has a dilatation at one end – ampulla which contains the sensory epithelium and opens into the vestibule .The nonampullated ends of superior and posterior canal meet and join forming the crus commune ,that enters the vestibule in the middle of the posterior wall .

The lateral canal slopes downwards and backwards and slopes at 30 degree angle to the horizontal in standing position ,other canals are at right angles

COCHLEA[12]

It is a coiled tube that makes two and half turns around a central pyramid of bone called modiolus ,and its base lies over the internal auditory meatus and transmits vessels and nerves to cochlea

Bony spiral lamina is a thin lamina of bone that arises from modiolus and spirals upwards within the lumen .Membranous spiral lamina extends from bony spiral lamina to outer wall of cochlea dividing into scala vestibule and scala tympani .These compartments are filled with perilymph and communicate with each other through a channel called helicotrema

Scala vestibule is closed at the oval window by the footplate of stapes and scala tympani by the secondary tympanic membrane at round window .It is connected with subarachnoid space through aqueduct of cochlea

MEMBRANOUS LABYRINTH[12]

It is a series of communicating sacs and ducts . Within the walls ,epithelium is specialized to form sensory receptors of cochlear and vestibular labyrinth .It is formed of cochlear duct ,utricle and saccule , the three semicircular canals and endolymphatic sac.

COCHLEAR DUCT[12]

It consists of spirally arranged blind tube called membranous cochlea or scala media which lies in the upper surface of spiral lamina . The cochlear duct is connected to saccule by the ductus reuniens .The length of basilar membrane increases from basal coil to apex ,resulting in high frequencies stimulating basal region and lower frequency stimulates apical region

UTRICLE AND SACCULE[12]

The saccule lies in the spherical recess opposite stapes foot plate ,maculae of saccule which is the sensory epithelium lies in anterior wall and responds to linear acceleration and deceleration

The utricle is larger occupying the posterior superior part of bony vestibule ,here the sensory epithelium macula lies in the lower part of lateral wall and responds to linear acceleration

SEMICIRCULAR DUCTS[12]

They are the 3 bony canals which open in utricle . The ampulla of each contains sensory cells on a saddle shaped ridge (crista ampullaris) that respond to rotatory movements

ENDOLYMPHATIC DUCT AND SAC[12]

The ducts of saccule and utricle unite to form endolymphatic duct that passes through the vestibular aqueduct . The terminal part is dilated to form the endolymphatic sac that lies between the two layers of dura on posterior surface of petrous bone .

BLOOD SUPPLY OF LABYRINTH[12]

The internal auditory artery (labyrinthine) ,a branch of anterior inferior cerebellar artery or sometimes the basilar artery supplies entire labyrinth.It divides into anterior vestibular and common cochlear arteries . The common cochlear arteries divides into cochlear and posterior vestibular arteries .Venous drainage is by the internal auditory vein ,vein of cochlear aqueduct and vein of vestibular aqueduct .

ANATOMY OF TEMPORAL BONE AND FACIAL NERVE

THE TEMPORAL BONE[12,13,14]

Temporal bone is a composite structure and is formed by tympanic bone ,the mastoid process,the squama,and the petrosa

FIGURE

THE TYMPANIC BONE[13,14]

Tympanic bone forms the anterior ,inferior,and parts of posterior wall of external auditory canal.Tympanic bone interfaces with squama at the tympano squamous suture ,mastoid at tympanomastoid suture and petrosa at petrotympanic fissure and constitutes the posterior wall of glenoid fossa .Laterally borders the cartilaginous external auditory canal and annulus sulcus lies medially .

THE SQUAMOUS BONE[13,14]

Squamous part of temporal bone serves as a lateral wall of middle cranial fossa .Squamous portion of temporal bone interfaces with parietal bone superiorly and with zygomatic process and sphenoid anteriorly .On the medial side middle meningeal artery grooves and lateral aspect middle temporal artery

MASTOID PROCESS[13,14]

The mastoid portion of temporal bone is the inferiorly extending projection which is seen along the lateral surface of temporal bone .It contains squamous portion laterally and medial portion petrous part and they are separated by Korner septum .

Temporal line is a horizontal ridge which continues from the superior border of zygomatic process and extends posteriorly to mastoid cortex .

Mc ewans triangle –imaginary line defined by three lines .Temporal line ,the posterior superior margin of external bony meatus ,and line perpendicular to temporal line and tangential to posterior wall of bony meatus .Mastoid antrum lies 1.2 cm-1.5cm deep to cortex.Fossa mastoidea ,a cribriform area in the triangle contains numerous peforating vessels . Mastoid foramen ,which is located posteriorly is traversed by mastoid emissary vein and mastoid arteries.

PETROUS PORTION OF TEMPORAL BONE[13,14]

Petrous can be seen in superior medial and posterior views .It is an extremely dense bone which protects the sensory organ of inner ear

Superiorly arcuate eminence corresponds to superior semicircular canal,other important features are meatal plane for internal auditory canal ,foramen spinosum for middle meningeal artery and facial hiatus for passage of greater petrosal nerve

Petrous apex points anteromedially and is marked by the transition of internal carotid artery ,orifice of bony eustachain tube and anterolaterally trigeminal ganglion within the meckels cave

Medially it has the internal auditory canal . The sigmoid sinus runs in the deep sulcus which is seen posteriorly and superior petrosal sinus runs in a sulcus located near the junction of posterior and middle fossa part of temporal bone . The endolymphatic fossa lies posterolateral to internal auditory canal

The inferior surface of temporal bone corresponds with sphenoid and occipital bone .Jugular fossa is separated from the internal carotid artery by jugulo carorid crest which is traversed by the tymapnc branch of glossopharyngeal nerve (Jacobsons nerve) .The stylomastoid foramen of facial nerve lies just posterior to styloid process.The digastrics muscle occupies medial aspect of the mastoid tip.The jugular foramen transmits 9,10,11 cranial nerves and lie posterior to internal carotid artery .

THE INTERNAL AUDITORY MEATUS[12]

A short canal which measures around 1 cm in length lined by dura passes into petrous bone in lateral direction from cerebellopontine angle . It is closed in its outer lateral end or fundus by a plate of bone that is perforated by passage of nerves and vessels

The bony plate at the fundus has a transverse crest on the medial surface which is the crista falciformis .Above and anteriorly lies the facial nerve which is separated by a vertical ridge (Bills Bar) from the superior vestibular nerve posteriorly ,the nerve supplies the superior and posterior semicircular canal ,utricle and part of saccule .Below the crest cochlear nerve lies anteriorly and inferior vestibular nerve posteriorly which supplies the saccule .

The Intratemporal part of Facial Nerve[12,13,14]

The motor fibres originate from facial nucleus in the pons .The sensory nerves relay into nucleus tractus solitarius in the pons .Secretomotor or parasympathetic fibres originate from superior salivatory nucleus .Sensory and secretomotor fibres form the nervus intermedius .Facial nerve and nervus intermedius run anterosuperiorly in the internal auditory meatus ,both join and complete at the fundus .

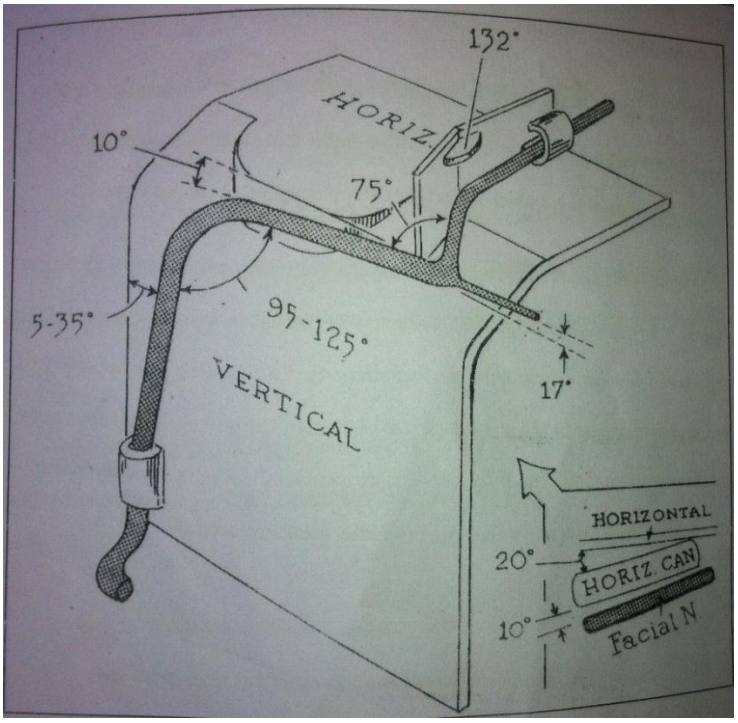


FIGURE 5: FACIAL NERVE :Intratemporal part

LABYRINTHINE SEGMENT[12,13] (4mm long)

From the fundus the nerve enters the canal ,surrounded by cerebrospinal fluid and runs between cochlea anteriorly ,superior semicircular canal posteriorly and with vestibule beneath it .This segment is narrowest part with an average diameter of 0.6 mm at the site of entry of nerve .On reaching the tympanic cavity it turns sharply backwards to make an angle of 60 degree .It relays in geniculate ganglion amd gives of the greater superficial petrosal nerve to supply the secretomotor fibres to lacrimal glands and glands of nose and palate and taste to palate .

Tympanic Segment[12,13,14] (13mm long)

The nerve runs posteriorly in the medial wall of tympanic cavity ,just above the promontory and oval window but below the prominence of lateral semicircular canal .Anterior end is marked by the processus cochleariformis .Above the oval window the nerves curves inferiorly .

MASTOID PORTION OF NERVE[12,13,14] (20mm long)

The nerve enters the descending portion at the level of pyramid where the sort process of incus lies laterally .In the descending portion the nerve lies posterior and deep to tympanic annulus .

The nerve emerges from stylomastoid foramen to enter the neck and passes forwards through parotid gland supplying the facial muscles

Nerve to stapedius arises at the beginning of descending portion and supplies the stapedius muscle .The chorda tympani nerve arises above the stylomastoid foramen ,and then supplies the taste sensation to anterior two thirds of the tongue and parasymapathetic fibres to submandibular and sublingual glands

MANIFESTATIONS AND MANAGEMENT OF OTOLOGICAL TRAUMA

Pinna Injuries

Trauma to the auricle occurs commonly in all age groups and as the pinna is exposed it easily vulnerable to trauma .As the auricular framework is made of an elastic cartilage pinna gets easily deflected and the chance of physical injury is less common .[16]

Trauma due to sharp or blunt instruments are more common.Thermal injuries are also common.[15,16,17]

Injury due to sharp instruments

Sharp object trauma ranges from lacerations to complete avulsion of auricle. Basic principle involves repair and prevent secondary infections.[16,18] Irrigation is the most important step in treatment as it removes all contaminants and foreign bodies.Cartilage repair is done by suturing of the posterior perichondrium or intercartilagnous suture 5-0 catgut .[19] Viable tissues should be saved.[22] Use of local flaps and skin grafts ,attempts are made to cover perichondrium and exposed cartilage followed by a light contour dressing.[19]

PINNA PARTIAL/COMPLETE AVULSION – Reattachment after washing debridement ,heparinisation done to prevemt microvascular clotting . Capillary circulation should be maintained for pinna survival ,microvascular reanastomosis techniques are employed.[15]

PERICHONDRITIS :

Most serious complication .Symptoms are initially characterized by red ,hot and n necrosis of cartilage .

auricular trauma should be treated promptly to prevent as it carries risk of added deformity due to perichondritis and deformity due to same is more dangerous than trauma itself.[1] Pseudomonas and mixed flora are the common pathogens should be treated by antipseudomonal antibiotics.[22]

Composite grafts from the opposite ear can be used ,costal cartilage and local pedicle flap .[23]

HEMATOMA[24]

Blunt traumas usually cause hematoma and this occurs in subperichondrial plane most commonly in the anterior portion of pinna resulting in fibrous tissue and new cartilage formation and cauliflower ear ,followed by a tightly fiiting plastic mould or a circumferential contour dressing or keeping a small drain.[24] Other approaches are placing a compression mattress suture after incision and drainage .[16,25,26]

Injuries like thermal injuries (frost bite and burns of auricle) can be superficial or deep .Thermal injuries lead to devitalization and necrosis of tissue causing infections leading to chondritis. They can be treated with antibiotics and in later stages by surgery (skin debridement and skin grafting).[20]

INJURIES TO EXTERNAL AUDITORY CANAL[24]

Can occur due to excessive cleaning of foreign body or cerumen .trauma to EAC trauma requires no treatment except for antiseptics and analgesics.[24]

FRACTURES OF EXTERNAL AUDITORY CANAL

A strong blow to the mandible drives the mandibular condyle into ear canal,resulting in fracture of anterior canal wall.Fractures can be a part of temporal bone fractures .Repositioning and packing the canal with impregnated wax is the main stay of management.[16]

Longitudinal fractures extends into bony canal wall and passes through the tympanic ring near the junction of scutum and tyampanomastoid suture .Injuries leave a step at bony annulus but they heal spontaneously .[16]Stenosis of external auditory canal can result from these injuries.[23,27]

Meatoplasty is an effective treatment as the injury results in stenosis of EAC .A postauricular incision is made and fibrous tissue and meatal skin are excised leaving behind skin on the roof and floor of external auditory canal .Bony meatus is widened using a drill and conchal cartilage is excised and conchla skin is placed back into position and sutured .The meatus is packed and skin is allowed for reepithelization .Skin split graft is necessary .

TYMPANIC MEMBRANE INJURIES

ETIOLOGY [17,23,28]

- most common cause of trauma to tympanic membrane is due to pressure change (blow over ear) and trauma to face,head injury (temporal bone fractures) followed by road traffic accidents and blast injuries

  Injuries to tympanic membrane produce perforations of varying size and type ,it may be associated with injuries to ossicular chain labyrinthine apparatus and trauma to facial nerve

  MANIFESTATIONS[17,24]

  There was associated bleeding and pain ,and the bleeding stopped spontaneously .There is an associated hearing loss and conductive type of around 40 dB .secondary infections may be associated .Temporal bone fractures resulted in injuries of posterior superior quadrant and the annulus .Injury to pars flaccid was minimal due to flaccidity .Tympanic membrane perforation was graded as grade 1 ,grade 2 and grade 3

MANAGEMENT

Many persons live their lives with tympanic membrane perforations that are entirely without symptoms.[29] Repair of such lesions is usually not indicated.

Cautery of the edges with Tri chloro acetic acid fastens the duration of healing.[30]

Perforations may be associated with recurrent infection when exposed to water. In swimmers, divers, and other water sports enthusiasts, repair may be indicated as a quality-of-life issue.

Hearing loss may be present, especially with larger perforations, and may be a reason for repair

Freshening of torn edges can be done with either with general anesthesia or local anesthesia .Procedure involves eversion of the edges and approximation and using a gel foam to support the fragments .[17]

Simple paper patching is another method .This method is employed in case where in the perforation remains dry and shows no signs of healing after 4 weeks .Cigarette paper is moistened with silver nitrate .Silver nitrate has an irriataing effect which stimulates healing[24] .Myringoplasty is indicated in large or symptomatic perforations.[24]

Post operatively audiometry reveals air bone gap closure . There is an increased possibility of post traumatic cholesteatoma occurring in EAC ,middle ear , mastoid process .

INJURY TO OSSICULAR CHAIN

Mechanism of ossicular chain injury is similar to the mechanism involved in perforation of tympanic membrane .

Hough and Stuart (1970)enlisted events which are related to ossicular chain injury .These can be individually associated or together may be related

Effective ossicular inertia occurring during periods of positive or negative accelrations of head.[32]

Vibratory impulse due to strong impacts

Tetanic contractions of middle ear muscles

Middle ear wall damage during longitudinal temporal bone fracture may cause fracture of middle ear structures

Trauma to the ossicular chain can occur in 3 different forms

Luxation

Fracture

Fixation

OSSICULAR INJURIES CLASSIFIED INTO 5 CATEGORIES BASED ON HOUGH AND STUART CLASSIFICATION.[33,34]

1) Malleus fracture
2) Massive dislocation of incus
3) Stapedial arch fracture
4) Incudo stapedial joint separation (MOST COMMON)
5) Epitympanic fixation of ossicular chain

Incudostapedial joint is most commonly injured ossicular chain irrespective of the type of injury or direction of injury.[35] Malleus is held by the connection with tympanic membrane and by the tensor tympani muscle ,incus is held weakly by the ligament in fossa incudis and stapes is held by the annular ligament and stapedial muscle.[35]

DISLOCATION OF INCUS

Incus is dislocated when the incudostapedial joint and the incudomalleolar joints are involved and incus may come to lie freely.[35]

In more severe trauma the incus may be completely rotated at an angle of 180 degree or completely missing

STAPES FRACTURE

Fractures of stapes super structure occurs at weakest point (Footplate attachment).[34]Severe injuries of the medial wall of middle ear cavity results in the oval window fractures and lead to displacement of stapes or fracture.[35]

OTIC CAPSULE SPARING FRACTURE cause epitympanic roof to break

The ossicular head becomes fixed in the epitympanum

Different pathologies may also be associated with fixation like hyperostotic bone,tympanosclerosis,post traumatic epitympanic fibrosis.[34]

SIGNS AND SYMPTOMS

Most commonly presents with conductive hearing loss

Bleeding ,pain is also present . The conductive hearing loss doesn't improve with repair of tympanic membrane.[24]

INVESTIGATIONS

Pure tone audiometry usually reveals 30-60 db of conductive hearing loss.[24]CT scan may show dislocated incus or malleus around 95% of time.[17]

TREATMENT

Surgical treatment is the main line of management ranging from simple repositioning to tympanoplasty to total ossicular replacement depending on the degree of trauma

APPROACHES – TRANSCANAL OR POST AURAL APPROACH[36]

Simple repositioning can be employed in cases of subluxation of incudostapedial joint.[34]

Tympanoplasty is done to reconstruct the conductive mechanism which has shown to improve the hearing.[17]

STAPES FRACTURE.[34]

STAPEDOTOMY is indicated when the foot plate is fixed

TOTAL OSSICULAR REPLACEMENT when stapes is fractured

EPITYMPANIC FIXATION

Removing incus ,malleus is nipped the neck and ossicular reconstruction is done with replacement prosthesis.[34]

SURGICAL EXPLORATION IS DONE ONCE HYPOTYMPANUM ,SOFT TISSUE RAECTION AND POSTRAUMATIC EFFUSION SUBSIDE.[13]

INNER EAR INJURIES

Direct fractures(severe closed head injuries) and neurolabyrinthine concussion is commonly associated with inner ear damage

MECHANISM OF INJURY

Inner ear structure may undergo violent displacement following accelerations and decelerations.[35]

Perilymph fistula.[34]

SENSORINEURAL HEARING LOSS

Mechanism which cause SNHL occur due to cochlear nerve and central auditory system.[34] Displacement of basilar membrane occurs due to the pressure which travel through the inner ear causing hearing loss in higher frequencies,being around 4000Hz.[38]

Severe or complete sensory neural deafness will be present and requires complete rehabilitation mainly by special listening devices and auditory training.[36]

VESTIBULAR DYSFUNCTION:

Vertigo occurs in all cases of trauma which causes sensorineural hearing loss.[39] .Labyrinthine concussion causes spinning sensation ,sensorineural hearing loss,nausea ,vomiting.Nystagmus is towards the involved ear . Central compensation sets in and slowly reduces the vertigo in over 3-6 weeks.[17] When the residual function of the labyrinth causes symptoms and also is shown by caloric excitability and positional nystagmus ,such patients are considered for labyrinthectomy.[36] Massive inujuries lead to vestibular deficits ,vertigo and vomiting and a fast horizontal nystagmus .Central compensation usually resolves the vertigo .[34]

BPPV (BENIGN POSITIONAL PAROXYSMAL VERTIGO) most commonly presented in case of posttraumatic vestibular dysfunction .40-50% of patients with temporal bone fractures present with BPPV and around 20-30% of patients with head injury.

BPPV occurs due to the rupture of macula of utricle thereby release of otoconia. Otoconia now freely floats in posterior semicircular canal .

Vertigo occurs when there is shifting of mass of otoconia with typical 5-7 seconds episode and lasting for 20-30sec .It occurs when the affected ear is placed down and its unilateral .It can last for about 3-4months if the condition is untreated .Vestibular suppression like antinauseants.[36] and repositioning manuevres as modified epley's manuevre is the main modality of treatment.[40]

CENTRAL CAUSE of vestibular dysfunction can occur due to cerebellar injury , brain stem nuclei injury or vestibular nerve tear . There may be associated other cranial nerve injuries and prolonged state of coma.[38]

Perilymph fistulas mainly is characterised by leak of perilymph from inner to middle ear .Mulitple etiologies are associated with it like fracture of stapes footplate ,rupture of stapediovestibular joint round window membrane rupture.[41]

Fluctuating progressive deafness,tinnitus,unsteadiness are the usual presenting features.[42]

Treatment is mainly bed rest with head end elevation of around 30-40 degree for a week.Surgical treatment involves repair of the round window membrane or oval window by exploratory tympanotomy or soft tissue plugging.[16]

FACIAL NERVE INJURIES

Second most commonly affected nerve in trauma.[43]Trauma can be blunt or penetrating trauma in motor vehicle accidents stab injuries of the face.[44]Bells palsy is the most cause of facial nerve injuries.[45]

Mechanism of trauma includes stretching ,compression,partial transection or complete transaction of nerve.[44] Facial nerve pathology in longitudinal temporal bone fracture showed intraneural edema /hematoma in 50%,17-45% showed bony spicule impingement ,nerve destruction in over 30% .

Injury to the facial nerve can occur anywhere it course .During temporal bone fractures intratemporal part is most commonly involved[44] ,the most common site of involvement being perigeniculate region(80-90%) of injuries affect the distal labyrinthine segment followed by the pyramidal eminence.[41,34]

Transverse fracture account to around 50% of facial nerve palsy and the longitudinal account to 20% of facial nerve palsy .Longitudinal fractures rarely result in total lysis of nerve.[35]

Duration of palsy can be either immediate type or delayed type[4].

Immediate type is usually related to severe transaction or trauma and is associated with worse prognosis , delayed paralysis carries a good prognosis and is due to nerve edema.[34]

Surgical intervention for nerve paralysis depends on criteria's mainly the timing of paralysis ,topographic testing and electrical testing.[34]

Topgraphic testing are done to identify the site of lesion which includes the shirmers test,submandibular salivary flow , stapedial reflex and electrogustometry.[34]

Electrical testing helps to determine prognosis of recovery . MST (maximal stimulation testing, electroneurography) .As per Fisch surgical treatment is done within 3 weeks in patients with an amplitude reduction of 90% by ENOG testing within a week.[46]

Site of injury can be demonstrated by CT Scan or Gadolinium enhanced DTPA .It allows planning for surgery.[43]

In case of delayed onset of paralysis a regular follow up is done and if the MST or ENOG shows progressive deterioration then a surgical decompression is done.[41,46,47,48,50]

Transmastoid ,extended transmastoid or middle cranial fossa approaches are also done.

TEMPORAL BONE FRACTURES

Temporal bone fractures accounts to about 20% of all skull fractures.[50]It can be due to penetrating or blunt trauma where in blunt trauma as the major cause of trauma.[34]

Risk of temporal bone fractures are more commonly seen among male than women ,Male to female 3:1 ratio .Motor vehicle accidents ,falls ,assaults ,gunshot injuries are the most common cause of fractures[34] . Motor vehicle accidents account to about 50% of cases

Fracture of temporal bone occurs due to tremendous force around 1875 pounds.[51]Temporal bone fractures due to blunt trauma occur at the structurally weakened site like foramina perforating the skull base.[50]

Temporal bone fractures are broadly classified into longitudinal and transverse fractures.[41]

Blows to temporal or parietal area is the most common cause of longitudinal fractures .This is the most common cause of fracture and forms around 70-80% of fractures .

Longitudinal fractures extend from the squamous part along the postersuperior canal wall of external auditory canal .the fracture then runs through the tegmen tympani ,front or behind the incudomalleolar joint .Near the geniculate ganglion it runs medially around the labyrinth .Labyrinth remains intact .Fracture then runs along the roof of eustachian tube or the carotid canal and along the anterior margin of petrous pyramid and reaches to end at the foramen lacerum.[41,52]

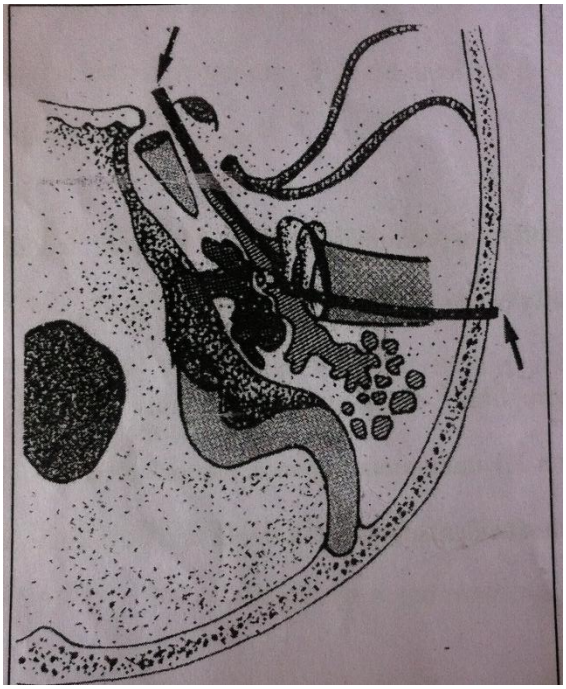


FIGURE 6: Longitudinal fracture

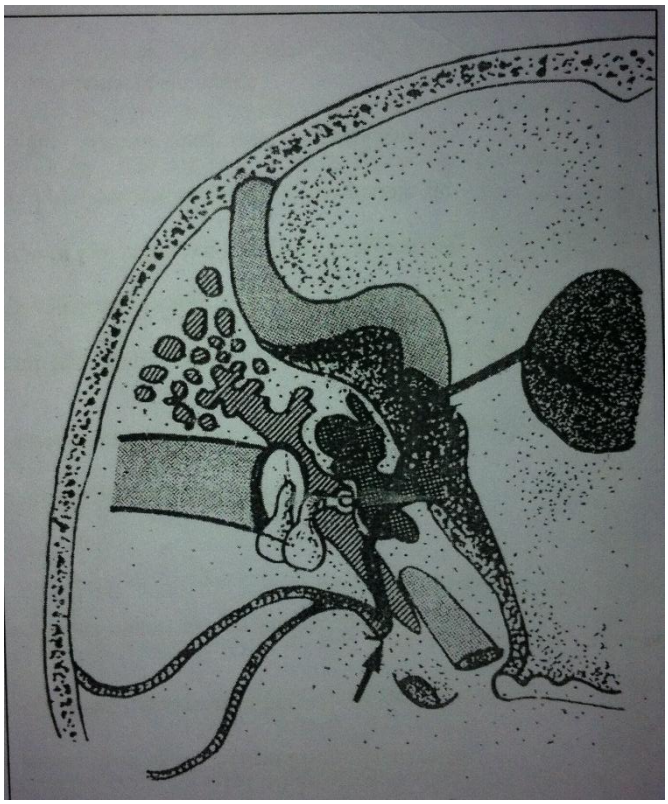


FIGURE 7:Transverse fracture.

Originate in the posterior fossa .These fractures pass through the petrous pyramid in the internal auditory canal and cause injury to the nerves in it and in the cochlea.Labyrinth is fractured at the region of horizontal part or geniculate ganglion .Fracture line is thereby intracapsular and lies perpendicular to long axis of petrous bone .Blows to occipitomastoid region result in transverse fracture and account to 30 % of temporal bone fractures.EAC , tympanic membrane and middle ear lie lateral to the fracture line.[33,41]

Powerful impact on the occipitomastoid region.[23]

Three dimensional high resolution CT scans show that majority of injuries occur due to oblique fractures or classic forms.[13,53]

SIGNS AND SYMPTOMS

Bleeding from the ear is the most common feature and indicates skull base fracture usually longitudinal type.[31]Duration can vary and can be scanty to profuse.[35] There may be associated hemotympanum.[54]There may be associated loss of consciousness but most commonly in transverse fracture.[19]

Hearing loss is usually of the sensorineural type in around 80 % of cases.Conductive hearing loss is commonly seen in longitudinal fractures due to bleeding into middle ear space or tympanic membrane ruptures .Usually these conditions resolve spontaneously .Ossicular chain injury leads to hearing loss(most commonly sensorineural hearing loss, conductive can also be seen). [15]

Battle's sign can occur after 4-5 days ,caused due to extravasation of blood pigments.[17]

Vertigo can be seen in majority of cases . This is most commonly seen with transverse fracture where the labyrinth is disrupted and causes severe vertigo until central compensation occurs.[43]

13 % of cases remember vertigo following a longitudinal fracture.[33]

Cerebrospinal fluid otorrhoea occurs with longitudinal fractures that disrupt the tympanic membrane along the floor of middle ear and posterior cranial fossa.There can be associated bleeding in early stages and can be recognized as a halo effect .CSF otorrhoea can be confirmed by glucose levels greater than 30 mg /100 ml.[57]Beta 2 transferrin assay is the most accurate procedure to know if the fluid is CSF.[3]

DIAGNOSIS OF TEMPORAL BONE FRACTURES

History and examination are important to diagnose temporal bone fractures.Fracture lines are seen only in about 50% on x-rays[34,56]

CT SCAN forms the main stay of imaging with axial and direct coronal plane in 1.0 or 1.5 mm sections using bone algorithms are optimal and are known as high resolution CT .

MRI helps in diagnosing any coexisting intracranial pathology . A pure tone audiogram in all patients helps in documenting overall condition of hearing status and also know the extent of hearing loss.[34]

MANAGEMENT OF TEMPORAL BONE FRACTURES

No special intervention is needed in cases of uncomplicated temporal bone fractures .Fracture of labyrinthine capsule leads to incomplete union and leads to growth of respiratory mucosa.[23]A good follow up for complications .Use of ear drops or an antibiotic pack in the EAC is avoided.[39] In case of a persistant hemotymapanum myringotomy is employed

CSF otorrhoea closes spontaneously in few days .Head end elevation to around 30 degrees and use of oral acetazolamide is the treatment of choice.[34] A lumbar subarachnoid drainage is required if CSF leak lasts for 5 days or more .If the CSF leak lasts longer then surgical closure of fistula is .[34]

COMPICATIONS FOLLOWING TEMPORAL BONE FRACTURES [4,57]

Dural tear can occur if the sharp edges of longitudinal or transverse fractures tear the dura and results in CSF otorrhoea

Risk of pneumatoceles was described first by Duken and Bezold where discharge of air from fractured mastoid under perisoteum as subperiosteal pneumatocele. These usually resolve spontaneously Meningitis is seen usually on 8-10 th day and is the most severe complicationof head injury .

Cholesteatoma occurs when a squamous epithelium gets trapped prior to a callus formation .This complication is seen with otic capsule sparing fractures .Squamous epithelium can get implanted

into middle ear through tear in the tympanic membrane . They are usually asymptomatic and when they present its usually atypical . HRCT is usually the imaging of choice .

Post traumatic cholesteatomas characteristically occur in well pneumatized temporal bone .In such cases extensive mastoidectomy is needed.[34]

MATERIALS AND METHODS

Total of 51 cases were studied during the study period and adequate follow up was done. Intervention was done wherever necessary.

SOURCE OF DATA

Patients with history of OTOLOGICAL TRAUMA presenting to RL JALAPPA HOSPITAL and research centre presenting to ENT DEPARTMENT AND CASUALTY during the time period of NOV 2012 to June 2014

INCLUSION CRITERIA:

ALL CASES OF OTOLOGICAL TRAUMA DUE TO ROAD TRAFFIC ACCIDENTS ,ASSAULTS AND BLAST INJURIES

EXCLUSION CRITERIA:

1.Barotrauma .

2. Noise induced hearing loss.

Period of study: NOV 2012- JUNE 2014

NUMBER OF CASES : 51

MODE OF SELECTION : EVERY CONSECUTIVE CASE

METHOD OF STUDY:

History and otological findings of each patient was recorded in the proforma

Detailed history and local examination including otological examination done and recorded

TYPE OF STUDY : Prospective,descriptive study

INVESTIGATIONS

X RAY MASTOIDS

X RAY SKULL

COMPUTERISED TOMOGRAPHY OF TEMPORAL BONE

AUDIOLOGY

PURE TONE AUDIOMETRY

TYMPANOMETRY

PREVENTIONS

Pinna Injuries

Under local anesthesia thorough washing was done with normal saline, hydrogen peroxide and betadine . Dead tissue was debrided.Skin edges were approximated with 4-0 silk .Mastoid dressing with contour maintainence was applied

Patients were explained about the risk of perichondritis and disfigurement .In case of a chondritis ,patients were treated with iv antibiotics and daily dressing.

TRAUMATIC TYMPANIC MEMBRANE PERFORATION

All patients with traumatic tympanic membrane were followed up for a period of 3 months. In view of persistant perforation and conductive hearing loss patients who came for follow up underwent surgery(TYPE 1 TYMPANOPLASTY- underlay technique)

TEMPORAL BONE FRACTURES

Patients were treated with prophylactic antibiotics and analgesics . Patients were advised not to use ear plugs or ear drops .CSF otorrhoea and vertigo was managed conservatively and follow up was done for 1 month ,followed by monthly follow up of 3 months .

Delayed onset facial nerve paralysis was managed by steroids and physiotherapy

OUTCOMES MEASURED

PINNA INJURIES

. Chondritis

.Deformity

.Healing without deformity

TRAUMATIC TYMPANIC MEMBRANE INJURIES

.Assessment of hearing by pure tone audiometry

. persistant perforation

Temporal Bone Fractures

Facial Nerve Paralysis

Hearing Loss after 3 months .

RESULTS AND OBSERVATIONS

60 cases of otological trauma entered the study. 9 cases were excluded from the study ,7 cases had severe head injury ,1 case had associated chest and abdominal injuries making otological assessment difficult ,1 case was unconscious for a long time.Hence the study consisted of 51 cases ,which included external ear ,tympanic membrane injuries and temporal bone fractures.

Mean age of the cases with otological trauma was 34.78±10.9.

Table 1: Age distribution of the subjects

Age	Frequency	Percent
<20yrs	6	11.8%
21 to 40 yrs	32	62.7%
>40 yrs	13	25.5%
Total	51	100%

Majority of the subjects i.e. 62.7% was in the age group of 21 to 40 yrs, 25.5% in the age group >40 yrs and 11.8% in the age group of <20 yrs.

FIG 8 : AGE DISTRIBUTION

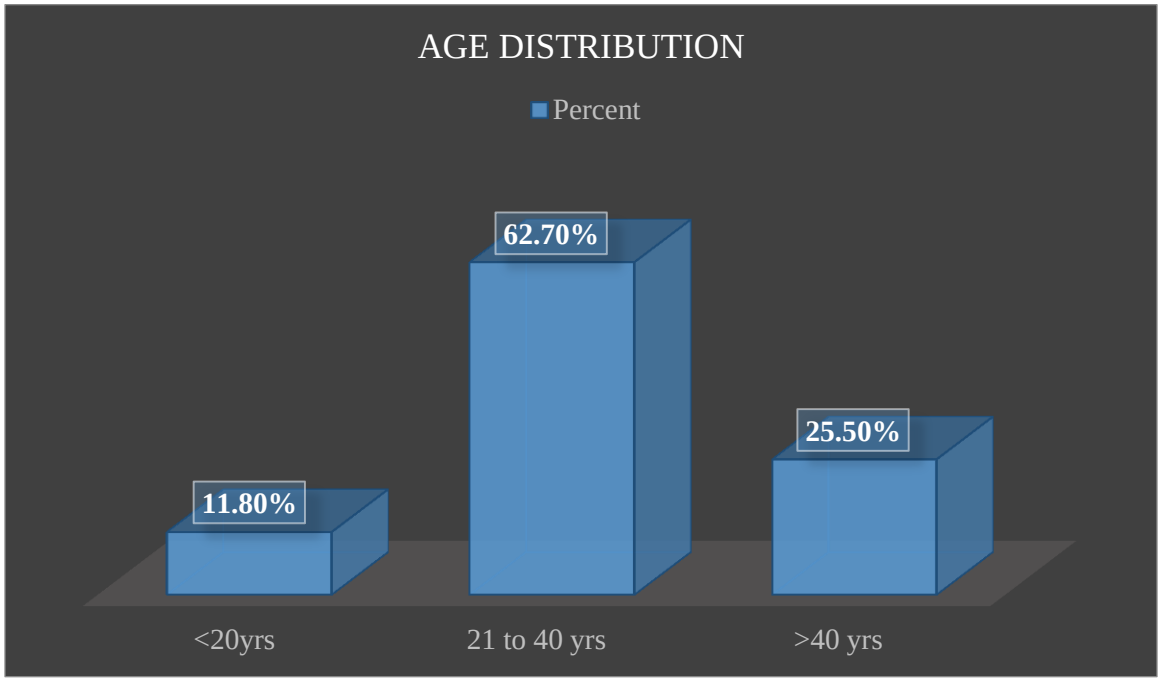


Figure 1: Bar diagram showing age distribution of subjects

Table 2: Sex distribution of the subjects

Sex	Frequency	Percent
Female	7	13.7
Male	44	86.3
Total	51	100%

FIGURE 9 :SEX DISTRIBUTION

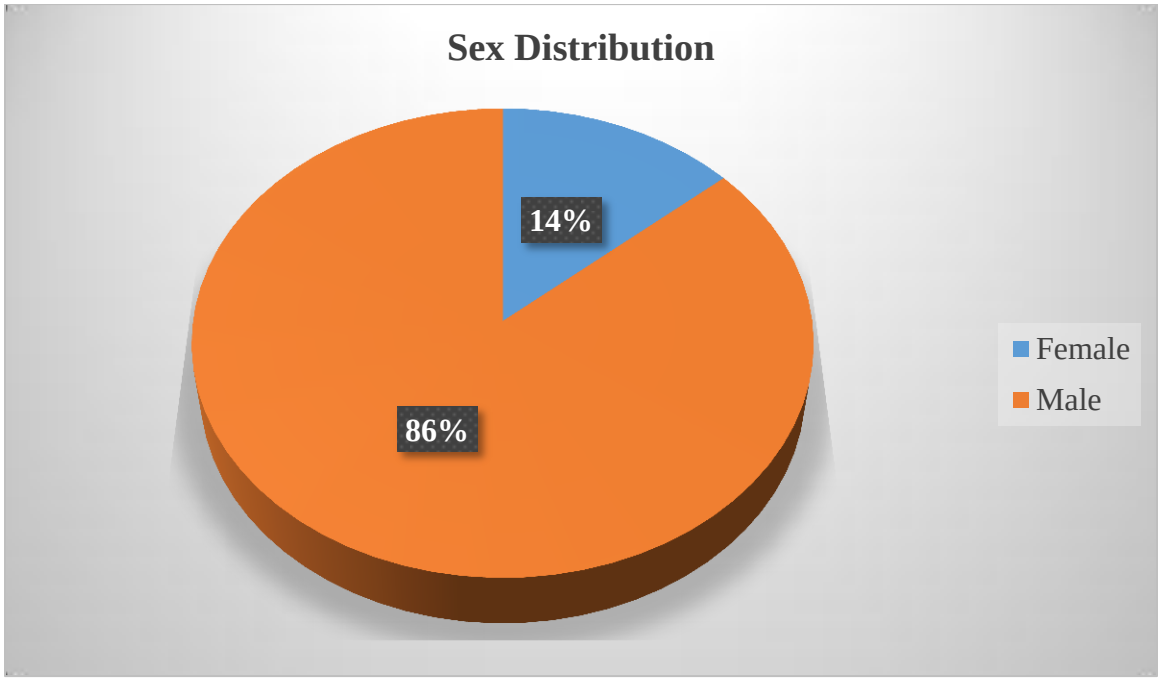


Figure 2: Pie diagram showing Sex distribution of subjects

Table 3: Distribution of the subjects according to Cause of Otological Trauma

Cause	Frequency	Percent
Assault	23	45.1
RTA	20	39.2
Fall	5	9.8
Self-Inflicted	3	5.9
Total	51	100.0

FIGURE 10 :ETIOLOGY OF OTOLOGICAL TRAUMA

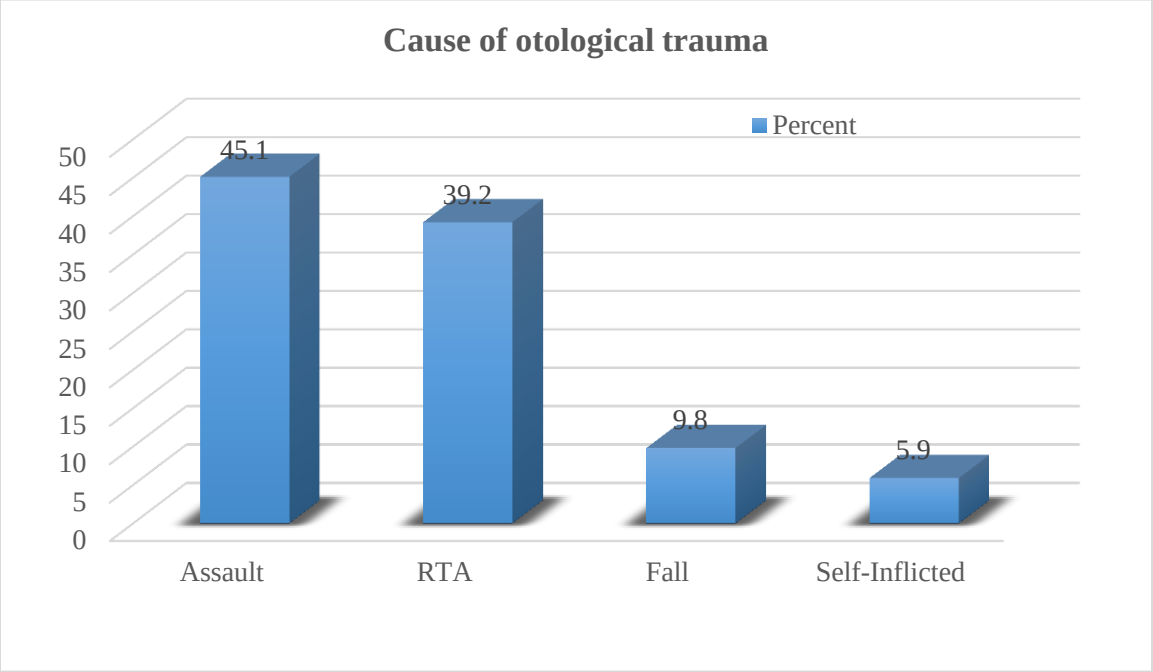


Figure 3: Bar diagram showing cause of Otological trauma among the subjects

Table 4: Association between Age and Cause of Otological Trauma among the study group

		Cause				Total
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
Age	**<20yrs**	2	4	0	0	6
	21 to 40 yrs	13	14	2	3	32
	>40 yrs	8	2	3	0	13
Total		23	20	5	3	51

X^2=9.426, df = 6, p = 0.151

In the study majority of Otological trauma was in the age group of 21 to 40 years and most common cause was Assault. There was no significant association between age and cause of Otological trauma.

FIGURE 11: AGE VS CAUSE DISTRIBUTION

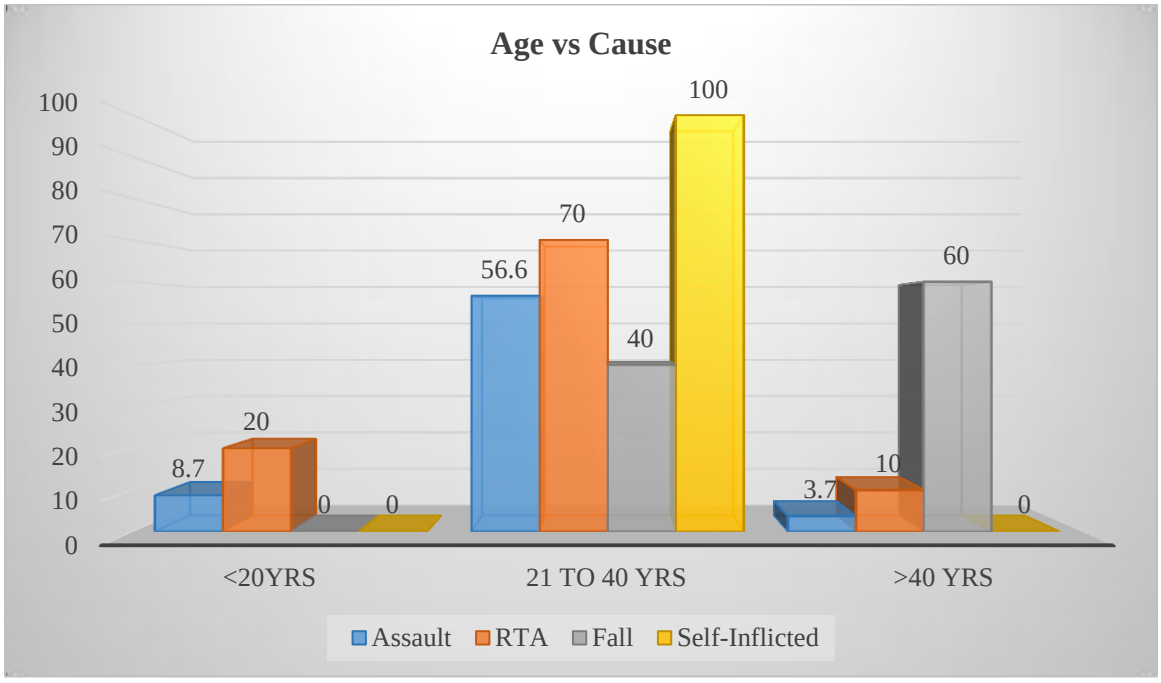


Figure 4: Bar diagram showing association between age and cause of Otological trauma

Table 5: Association between Sex and Cause of Otological Trauma among the study group

		Cause				Total
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
Sex	**Female**	4	1	1	1	7
	Male	19	19	4	2	44
Total		23	20	5	3	51

X^2=2.687, df = 3, p = 0.442

Majority of Otological trauma was seen among males and most common cause for trauma was Assault. There was no significant association between age and cause of Otological trauma.

FIGURE 12: AGE VS SEX DISTRIBUTION

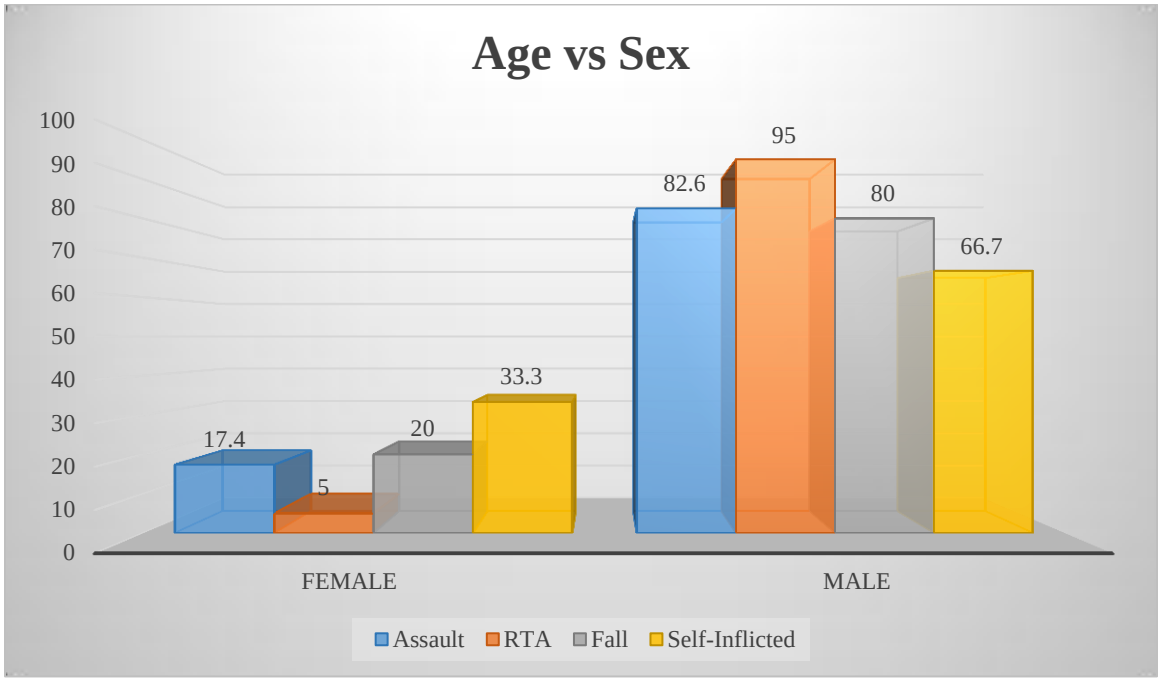


Figure 5: Bar diagram showing association between age and sex

Table 6: Distribution of subjects according to Pinna Injury

		Frequency	Percent
Pinna Injury	**No Injury**	20	39.2
	Right	25	49.0
	Left	6	11.8
	Total	51	100.0

In the study 31 cases had pinna injury of which 25 was on right side and 5 was on left side.

Table 7: Distribution of subjects according to CSF Otorrhea

		Frequency	Percent
CSF Otorrhea	**Absent**	50	98.0
	Right	1	2.0
	Total	51	100.0

In the study only one case presented with CSF Otorrhea on right side.

Table 8: Distribution of subjects according to EAC (External auditory canal) Injury

		Frequency	Percent
EAC injury	No Injury	32	62.7
	Right	13	25.5
	Left	6	11.8
	Total	51	100.0

In the study 19 cases had External auditory canal injury of which 13 was on right side and 6 was on left side.

Table 9: Distribution of subjects according to Ear Bleeding

		Frequency	Percent
Ear Bleeding	**No Injury**	28	54.9
	Right	17	33.3
	Left	6	11.8
	Total	51	100.0

In the study 23 cases had ear bleeding of which 17 was from right side and 6 was from left side.

Table 10: Distribution of subjects according to Traumatic Tympani Membrane Perforation

		Frequency	Percent
Traumatic Tympani Membrane Perforation	No Injury	34	66.7
	Right	8	15.7
	Left	9	17.6
	Total	51	100.0

In the study 17 cases had Traumatic Tympani Membrane Perforation of which 8 was on right side and 9 was on left side.

Table 11: Distribution of subjects according to Hemo tympanum

		Frequency	Percent
Hemo tympanum	Absent	50	98.0
	Right	1	2.0
	Left	0	0
	Total	51	100.0

In the study only one case had Hemo tympanum on right side.

Table 12: Distribution of subjects according to Facial Palsy

		Frequency	Percent
Facial palsy	Absent	47	92.2
	Right	3	5.9
	Left	1	2.0
	Total	51	100.0

In the study 4 cases had facial palsy of which 3 was on right side and 1 was on left side

Table 13: Distribution of subjects according to Hearing Loss

		Frequency	Percent
Hearing Loss	Absent	46	90.2
	Right	2	3.9
	Left	3	5.9
	Total	51	100.0

In the study 5 cases had hearing loss due to trauma, of which 2 was on right side and 3 was on left side.

Table 14: Distribution of subjects according to Vertigo

		Frequency	Percent
Vertigo	Absent	49	96.1
	Right	1	2.0
	Left	1	2.0
	Total	51	100.0

In the study only 2 cases presented with vertigo of which 1 was on each side.

Table 15: Distribution of subjects according to Temp Bone#

		Frequency	Percent
Temp Bone#	Absent	36	70.6
	Right	9	17.6
	Left	6	11.8
	Total	51	100.0

In the study 15 cases had Temporal bone fracture of which 9 was on right side and 6 was on left side.

Table 16: Association between Cause and Pinna Injury

		Cause				Total
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
Pinna Injury	**Left Ear**	4	2	0	0	6
	No Injury	2	12	3	3	20
	Right Ear	17	6	2	0	25
Total		23	20	5	3	51

X^2=18.59, df = 6, p=0.005**

In the study it was observed that there was significant association between Pinna injury and cause. Pinna injury was common on right side among all the causes of Otological trauma.

Table 17: Association between Cause and CSF Otorrhea

		Cause				Total
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
CSF Otorrhea	**Absent**	23	19	5	3	50
	Right Ear	0	1	0	0	1
Total		23	20	5	3	51

X^2=1.581, df = 3, p=0.664

In the study it was observed that there was no significant association between CSF Otorrhea and cause. CSF Otorrhea was seen in one patient on right side.

Table 18: Association between Cause and EAC injury

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
EAC injury	Left	0	6	0	0	6
	Absent	21	8	3	0	32
	Right	2	6	2	3	13
Total		23	20	5	3	51

X^2=25.479, df = 6, p=0.0001**

In the study it was observed that there was significant association between EAC injury and cause. EAC injury was common on right side among all the causes of Otological trauma and it was common in RTA.

Table 19: Association between Cause and Ear Bleeding

		Cause				**Total**
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
Ear Bleeding	**Left**	0	5	1	0	6
	Absent	18	7	3	0	28
	Right	5	8	1	3	17
Total		23	20	5	3	51

X^2=17.18, df = 6, p=0.009**

In the study it was observed that there was significant association between Ear Bleeding and cause. Ear Bleeding was common on right side among all the causes of Otological trauma. Ear Bleeding was common in RTA.

Table 20: Association between Cause and Traumatic TM Perforation

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Traumatic TM Perforation	Left	5	4	0	0	9
	Absent	13	14	4	3	34
	Right	5	2	1	0	8
Total		23	20	5	3	51

X^2=, 4.194,df = 6, p=0.650

In the study it was observd that there was no significant association between Traumatic TM Perforation and cause. Traumatic TM Perforation was common on left side among all the causes of Otological trauma. Traumatic TM Perforation was common in RTA cases.

	Before Surgical intervention	N	Mean	Std. Deviation	p value
PTA	Left ear	3	22.33	1.528	0.428
	Right ear	4	23.50	1.915	

Only 7 patients gave consent for surgical interventions and Pre op PTA evaluation was done in these cases. PTA showed mild hearing loss in all the 7 cases.

Table 21: Association between Cause and Hemo tympanum

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Hemo tympanum	Absent	23	19	5	3	50
	Right Ear	0	1	0	0	1
Total		23	20	5	3	51

X^2=1.581, df = 3, p=0.664

In the study it was observed that there was no significant association between Hemo tympanum and cause. Hemo tympanum was found on right side in only one case.

Table 22: Association between Cause and Facial Palsy

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Facial Palsy	Left	0	1	0	0	1
	Absent	23	16	5	3	47
	Right	0	3	0	0	3
Total		23	20	5	3	51

X^2=6.728, df = 6, p=0.347

In the study it was observed that there was no significant association between Facial Palsy and cause. Facial Palsy was found only in RTA cases and was more common on right side.

Table 23: Association between Cause and Hearing Loss

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Hearing Loss	Left	1	2	0	0	3
	Absent	22	17	4	3	46
	Right	0	1	1	0	2
Total		23	20	5	3	51

X^2=5.74, df = 6, p=0.453

In the study it was observed that there was no significant association between Hearing Loss and cause. Hearing Loss was found only in RTA cases and was more common on right side.

Table 24: Association between Cause and Vertigo

		Cause				Total
		Assault	**RTA**	**Fall**	**Self-Inflicted**	
Vertigo	**Left**	0	1	0	0	1
	Absent	23	18	5	3	49
	Right	0	1	0	0	1
Total		23	20	5	3	51

X^2=3.227, df = 6, p=0.780

In the study it was observed that there was no significant association between Vertigo and cause. Vertigo was found only in RTA cases and was more common on right side.

Table 25: Association between Cause and Temporal Bone#

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Temporal Bone#	Left	0	5	1	0	6
	Absent	22	9	2	3	36
	Right	1	6	2	0	9
Total		23	20	5	3	51

X^2=17.237, df = 6, p=0.008**

In the study it was observed that there was significant association between Temporal Bone# and cause. Temporal Bone# was common in RTA cases and on right side.

Table 26: Association between Cause and Perichondritis

		Cause				Total
		Assault	RTA	Fall	Self-Inflicted	
Perichondritis	N	17	17	5	3	42
	R	6	3	0	0	9
Total		23	20	5	3	51

X^2= 2.93 df = 3, p=0.401

In the study it was observed that 9 cases had Perichondritis on right side. There was no significant association between cause of trauma and Perichondritis.

Table 27:Symptoms of temporal bone fracture

Symptoms	**Number (n=15)**	**Percentage**
Ear bleeding	**11**	**73.3%**
Hearing Loss	**3**	**20%**
CSF Otorrhoea	**1**	**6.67%**
Vertigo	**1**	**6.67%**

In the study done among 15 temporal bone fractures 73.3% had ear bleeding,20% conductive type hearing loss by audiometry and 6.67% had CSF otorrhoea and vertigo respectively .

Table 27: Outcome during follow up

		Frequency (n=51)	Percent
Pinna deformity	No	49	96.1
	Yes	2	3.9
Hearing loss	Present	4	7.8
	Absent	47	92.2

During follow up only 2 patients had Pinna deformity and 4 patients had Conductive hearing loss.

Out of 17 patients with TM perforation only 7 subjects [3 left side and 4 right side TM perforation] came for follow up and underwent tympanoplasty.

Patients who underwent surgical intervention for TM perforation were followed up for 3 months. During this period the TM perforation had healed and graft had taken up well.

Mean duration of healing after tympanoplasty was 15.43 ± 4.19 days.

Out of 4 patients who had facial palsy one patient was not willing for surgical intervention and 3 patients had delayed onset facial palsy and was treated with systemic steroids. Physiotherapy and was followed up. During the follow up all the three patients recovered from facial palsy.

DISCUSSION

Otological injuries are one of the most common presentations in the emergency department .

Otological injuries lead to impairment of important functions like hearing and balance .

Disfugurement is also commonly seen in injuries of the external ear i.e pinna .

It has been observed that people in the age group of 20-40 years are most commonly affected.

The incidence of otological injury is higher among males than females.

Assaults were the commonest mode of injury followed by road traffic accidents .Two wheeler accidents were the most common cause observed.

Alcohol consumption was found to be the commonest contributory factor.

The most common symptom associated with otological injuries was ear bleeding .

The other common symptoms associated were pinna injury leading to perichondritis ,facial palsy ,hearing loss and vertigo .

PINNA INJURIES:

In our study pinna injuries were seen in around 60 % of all patients . The most common cause was assault followed by RTA and fall. Majority of these cases healed without complications, but two cases in our study developed perichondritis and pinna deformity (FIG 13).In one case there was deformity because of amputation of part of pinna (FIG 13B)

EARLY PHASE: Patients presented with dull pain ,redness ,warmth and swelling

Organisms – Pseudomonas aeruginosa and Staph aureus ,rarely MRSA.

One of the patients had pseudomonas on pus culture and sensitivity and patient was treated with antipseudomonal antibiotics and follow up was done after 3 months, no deformity was visible .

This compared with the study done by Steete BD ,Breennan PO[58](2002) who reported that lacerations of pinna were the common form of injury and formed around 56% .

As per the study done by Templer J,Renner GJ[2](1990) most lacerations of external ear were caused due to motor vehicle accidents , brawls and job related injuries .

Pinna healed in a vast majority of cases if proper aseptic precautions were observed .

Chondritis was the most common complication .Repair is greatly influenced by possibility of chondritis .

Complications of auricular lacerations have poor cosmetic results due to chondritis as per the study done by William P Potsic ,Robin T Cotton ,Steven D Handler [19] (1997).

Chukuezi A.B.,Nwosu J. N. Ear Trauma in Orlu, Nigeria: A Five-Year Review Indian J Otolaryngol Head Neck Surg 2012 Mar-Jul ;64(1):42–45.[59]

RTA and Assaults was the common cause of auricular trauma.

Figure 13: Perichondritis of Ear

Figure 13A: Necrosis of Auricular Cartilage

Figure 13B:Follow up: After 2 weeks **4 weeks**

REMOVAL OF NECROSED PART. PARTIAL AMPUTATION OF PINNA

TYMPANIC MEMBRANE INJURIES:

In our study, a total of 17 patients had traumatic tympanic membrane perforations (Fig 14) .Assault was the most common cause of injury(11) followed by RTA (5)- Out of 17 of these cases left side was the common site of injury in 9 cases and right side in 8 cases.

Among the 17 patients who had tympanic membrane perforations. Follow up was done for 3 months. At the end of 3 months only 7 members came for follow up ,these 7 members had a persistant perforation and were advised a tympanoplasty .All seven members underwent a PTA and it showed mild to moderate conductive hearing loss .All of them underwent TYPE 1 TYMPANOPLASTY (surgical intervention).In our study underlay technique was employed .

Average duration of healing observed was 3 weeks .Patients were followed up for a period of 3 months .TM had healed and graft had taken up well .After healing, PTA was done and all showed closure of air bone gap confirming that hearing loss was due to tympanic membrane perforations only.

A study done by Lindeman P,Edstrom S ,Granston G [61](1987) showed that traumatic tympanic membrane perforations occurred more commonly due to trauma from others ,than self induced injuries .In their study 39 patients had traumatic tympanic membrane perforations, and 37 of them healed in 2months period without any hearing disability.

Study done by Lou Z [61] in 2012 showed that assault was the most common cause of tympanic membrane perforations.Study also showed that traumatic perforations have an excellent prognosis .

A clinical study of traumatic tympanic membrane perforation done by Seong Ho Chun,Dae Won Lee and Jong Keun Shin [62]at the Department of Otolaryngology ,Seoul Korea, showed that mean duration of complete healing in uncomplicated case was 22,1 days after a myringoplasty .

.

Assault and direct trauma were the most common etiological causes .Mean age was 21-40 years .Hearing loss was in the range of 26-35db .Slap injury was the most common cause. Majority of cases had conductive hearing loss .Majority healed without any intervention .Following tympanoplasty the average duration of healing was around 21 days as per the study done by

Satish HS ,Saurabh R and Sarojamma [63]on Clinical study of traumatic tympanic membrane perforation in 2013

Another study done Fernandez ,Sharma VM, Ameede RG[64] on traumatic tympanic membrane perforations showed that open hand blow was the most common cause.Pure tone audiometry showed conductive hearing loss of 20db.

TEMPORAL BONE FRACTURE

In our study 15 patients had temporal bone fractures ,11 were caused by motor vehicle accidents (73%) , 3 were due to fall (20%) and 1 (6%) was due to assault . 14 out of 15 cases had longitudinal fractures and 1 had transverse fracture .Ear bleeding was the most (FIG 17)common complaint of temporal bone fractures (73%) followed by hearing loss (20%) ,CSF otorrhoea 2 % and vertigo (6%) .

Examination showed external auditory canal injury in around 30%. Tympanic membrane tear was seen in 33% of cases. Facial nerve injury was seen in around 7% of cases. One patient (2%) had hemotympanum. Ossicular chain injury was not evident radiologically .

A study done by P S Chatar [65] 2011 showed that blunt trauma in EAC was most commonly due to road traffic accidents

Motor vehicle accidents remained the primary cause of temporal bone fractures and accounted for around 45% of cases ,falls around 31% ,blunt assaults and gun shot injuries 17% as per the study done by Ishman SL and Triedlend DR [66](2004)

Temporal bone fractures were seen in around 30 cases ,out of which 25 (84 %) cases had longitudinal fractures(FIG 16) and 4 (13%) transverse fractures .Ear bleeding was common in cases of longitudinal fractures ,vomiting in 16 cases , CSF otorrhoea (3 cases) , vertigo (15 cases) tinnitus (8 cases) ,unconsciousness (7 cases) facial palsy (7 cases),ossicular discontinuity was seen in 5 cases as per a study done by Grewal DS and Hathiram . [5] 1998.

A study done on prognosis of hearing loss in temporal bone fractures by TOS[14] (1970),conductive hearing loss occurring due to acute injury resolved spontaneously in 80% of cases .Patients with sensorineural hearing loss did not show improvement .

Another study done by Hanrado Cario,Lee Dennis,Goldsmith Ari,Har El Gadg [67] in 1998 on 79 temporal bone fractures, 82% had conductive hearing loss,81% hemotympanum, 58% otorrhoea and 3% facial palsy.

Hearing loss due to trauma occured in 22.5% cases of temporal bone trauma and 16-30% had conductive hearing loss as per study done by Ghoyareb B.Y,Yeakly J.W,Hall J.W,Jones E.[4]

In our study 20 % had conductive hearing loss associated with temporal bone fractures.Amongst these all patients had hearing loss of mild to moderate degree on pure tone audiometry

FACIAL PALSY

Facial nerve palsy was seen in 4 patients . 3 patients with temporal bone fractures had delayed onset of facial nerve palsy GRADE 2 as per House Brackman grading system FIGURE 18.All of them had medical line of management with steroids and physiotherapy. One patient who had GRADE 3 facial palsy was advised surgical decompression ,but this patient went against medical advise and was lost for follow up .

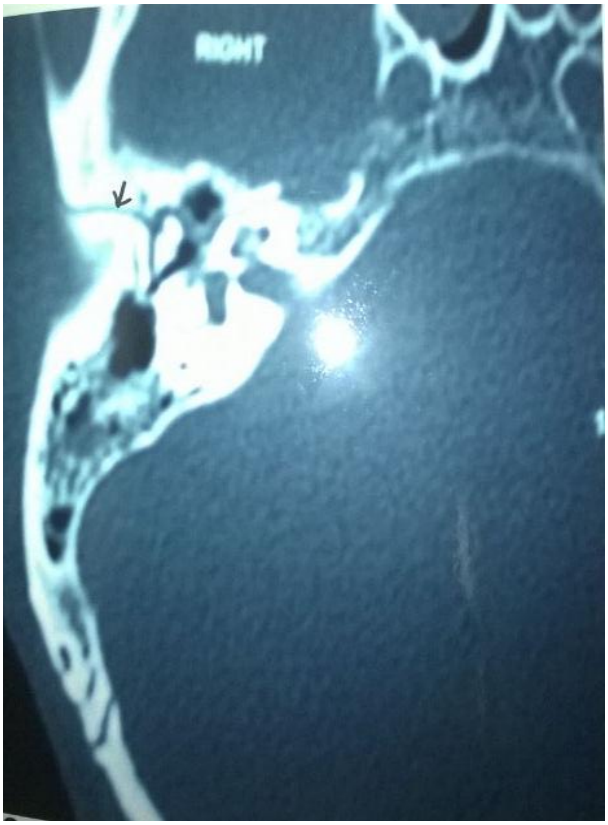
LEE DENNIS et al [67] (1998) showed in their study in around 79 cases of temporal bone fractures 3% cases (2 cases) had facial nerve palsies.

Adour KK et al[68] (1977) showed around 76% achieved complete recovery of delayed onset of facial palsy.

Facial paralysis was reported in 15 % adults and 6-20% of children with temporal bone fractures as per study done by David A Moffat[43] (1998) .

Another study done by Brodie ,Hillary ,Thompson,Teresa (1997) on complications of temporal bone fractures in 820 bones, showed that all patients with delayed onset of facial paralysis had good recovery of function .Surgical treatment was seldom indicated .

FIG 14 TRAUMATIC TM PERFORATION(RIGHT SIDE)



LONGITUDINAL FRACTURE OF TEMPORAL BONE(FIG 15)

LEFT EAC BLEED(FIG 16)

FIG 17:FACIAL NERVE PALSY

CONCLUSIONS

Otological injuries require timely and appropriate intervention in order to reduce morbidity.

Quick medical and surgical interventions can help prevent disfigurement due to perichondritis of pinna.

Traumatic tympanic membrane perforations heal without any interventional procedures like tympanoplasty .

As majority of cases occur due to motor vehicle accidents (two wheelers) use of helmets can prevent the risk of head injuries (temporal bone fractures)

Education of people against use of alcohol during driving and enforcing strict traffic rules help in decreasing the risk of otological trauma.

SUMMARY

51 cases of otological trauma and their management was studied at SRI DEVARAJ URS MEDICAL COLLEGE KOLAR during the study period of NOVEMBER 2012 AND JUNE 2014

Most common cause of otological injuries was assault followed by road traffic accidents and fall. Association of alchololism was seen in most cases.

Highest incidence was seen among males (86%) in the age group 21-40 years (62.7%)

Pinna was affected in about 60% of cases. 17.6% of cases developed perichondritis and 4% developed pinna deformity .

Assault was the most common cause of traumatic tympanic membrane perforations (commonly by a slap on left cheek) around 65% .

Surgical intervention resulted in a shorter healing duration

Temporal Bone fracture was most commonly seen with Motor vehicle accidents (73%) . Ear bleeding and hearing loss were the common symptoms .Vertigo was one of the common presentations.

The commonest type of hearing loss was conductive type which returned to normal after conservative/surgical management

Facial nerve injury was seen in 4 patients . 3 patients had delayed onset of facial nerve palsy which recovered on conservative management .

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ANNEXURE -1

PROFORMA.

I. Personal details

Name: Age: Sex: M/F

Occupation: Hospital number:

DOA: DOD:

Address:

Phone number:

II. History of presenting complaints

a. Trauma: Y/N DATE & TIME :

Type: RTA /ASSAULT/SELF INFLICTED

b. DISCHARGE :

Blood staining: Y/N

c.PAIN :Present/absent

DEGREE :Mild /moderate /severe

d.SWELLING /EDEMA :Present/Absent

e.Decreased hearing: Y/N Duration:

Degree:Mild /Moderate /Severe

Type :conductive /SN/mixed

f. Associated Symptoms

CSF Otorrohea :Present/Absent Intermmitent/Continuos
Vertigo : Present/Absent Intermmitent/Continuous
Tinnitus:Prsent/Absent Intermmitent/Continuous
Nausea /Vomitting:Present/Absent

g. Associated Injuries :

FACIAL WEAKNESS:PRESENT/ABSENT DEGREE :

III. Past history
History of Hypertension/ Diabetes mellitus/ Tuberculosis/ Bronchial asthma
History of ear surgeries in the past: Y/N ; If yes:
History of trauma in the past :Y/N;if yes:

IV. Family history
V. History of having undergone treatment for the same :
VI. Personal history
Appetite:N/Decreased Disturbed sleep: Y/N
Diet: Bowel & Bladder disturbances: Y/N
Smoker: Y/N ; If yes: Duration: Quantity: Type:
Alcoholic:Y/N If yes: Duration: Quantity: Type:

Examination

VII. General physical examination:
Level of consciousness:
Temperature: Pulse: BP:
Pallor: Y/N Icterus: Y/N
Cyanosis: Y/N Clubbing: Y/N
Lymphadenopathy: Y/N Oedema: Y/N

VIII. ENT examination

A. Ear examination:

Sl No	Ear	Right	Left
1	Preauricular area:		
2	Pinna:		
3	Postauricular area:		
4 5	External auditory canal: Discharge		
6	Tympanic membrane		
7	Middle ear mucosa Colour Oedematous Granulation tissue	 Pale/ congested Y/N Y/N	 Pale/ congested Y/N Y/N
8	FACIAL NERVE		

9 10	Tuning fork tests Rinnes Webers ABC Nystagmus	 +ve/-ve R/L/C Normal/ reduced	+ve/-ve R/L/C Normal/ reduced

B. Nose examination:

Sl No	Nose	Findings
1	External framework:	
2	Vestibule	
3 4	Anterior rhinoscopy Posterior rhinoscopy	
5 6	Paranasal sinuses Diagnostic nasal endoscopy	

C. Throat examination:

Sl No	Throat	Findings
1	Oral cavity and oropharynx	
2	Indirect laryngoscopy	

D NECK EXAMINATION

Examination

Cardiovascular system: Respiratory system:

Abdomen: Central nervous system:

IX. Clinical diagnosis

X. Investigations

Hb- TC- DC- BT- CT-

HIV- reactive/ non-reactive HbSAg- reactive/ non-reactive

X-ray mastoids-

PTA-

XI. Otomicroscopy findings:

Sl no		Findings
1		
2		

XII.Follow up

KEY TO MASTER CHART

ANNEXURE 2

L- LEFT

R- RIGHT

TM -TYMPANIC MEMBRANE

#- FRACTURE

TB -TEMPORAL BONE

CHL -CONDUCTIVE HEARING LOSS

EAC –External auditory canal

CSF –cerebrospinal fluid

PTA –pure tone audiometry

Name	Age	Sex	Cause	Causerecoded	PinnaInjury	CSFOtorrhea	EACinjury	EarBleeding	TraumaticTMPerforation	Surgicalintervention	Durationofhealing	Hemotympanum	FacialPalsy	HearingLoss	PTAbeforesurgery	Vertigo	TempBone#	Followup	Perichindritis	Pinnadeformity	Hearinglo ss_A	Facialpals y_A	Agerecoded
MOHAMMAD ALI	29	M	ASSAULT	1	L	N	N	N	L		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
SHANKARANANDA	40	M	RTA	2	N	N	L	L	L		#NULL!	N	N	N	#NULL!	N	L	#NULL!	N	N	N	L	2
RAKESH REDDY	32	M	FALL	3	N	N	N	L	N		#NULL!	N	N	N	#NULL!	N	L	#NULL!	N	N	N	L	2
ABHISHEK	20	M	RTA	2	N	N	L	L	L		#NULL!	N	N	L	22	N	L	#NULL!	N	N	L	L	1
SHIVASHANKAR	40	M	RTA	2	N	N	L	L	N		#NULL!	N	N	N	#NULL!	L	N	#NULL!	N	N	L	L	2
RANGAPPA REDDY	27	M	RTA	2	N	N	N	R	R	R	18	N	R	N	22	N	R	#NULL!	N	N	R	N	2
SHIVANNA	32	M	ASSAULT	1	N	N	N	N	L		#NULL!	N	N	L	28	N	N	#NULL!	N	N	N	N	2
GANESH KUMAR	40	M	RTA	2	N	N	L	L	L		#NULL!	N	N	N	#NULL!	N	L	#NULL!	N	N	N	N	2
NIKHIL GOWDA	20	M	RTA	2	N	N	L	L	L		#NULL!	N	N	N	#NULL!	N	L	#NULL!	N	N	N	N	1
HANUMA REDDY	28	M	ASSAULT	1	L	N	N	N	L		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
LINGAPPA	30	M	ASSAULT	1	L	N	N	N	L	L	12	N	N	N	22	N	N	#NULL!	N	N	N	N	2
BABU	44	M	RTA	2	L	N	N	N	N	L	13	N	N	N	21	N	N	#NULL!	N	N	N	N	3
NARASIMHAMURTHY	40	M	ASSAULT	1	R	N	N	N	R		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	R	N	N	2
GURU SINGH	20	M	ASSAULT	1	R	N	N	N	R		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	R	N	N	1
RAAJANNA	26	M	ASSAULT	1	R	N	R	R	R		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
GURURAJ	28	M	SELF INFLICTED	4	N	N	R	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
ASIF KHAN	28	M	SELF INFLICTED	4	N	N	R	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
LALITHAMMA	33	F	SELF INFLICTED	4	N	N	R	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
ALLAHBAKSH	35	M	RTA	2	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
GANGAMMA	45	F	ASSAULT	1	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3
SURESH GOWDA	30	M	ASSAULT	1	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
RANGAPPA	40	M	ASSAULT	1	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
ANTHONY	30	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
SHOBA	45	F	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3
SUVARNAMMA	47	F	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3
MANJUNATH	20	M	RTA	2	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	1
LINGAMMA NAIDU	47	F	FALL	3	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3
RAMANNA SHETTY	35	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
MASTAAN SAAB	50	M	FALL	3	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3
RAMESHAPPA	30	M	RTA	2	L	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
SEETHAMMA	50	F	ASSAULT	1	L	N	N	N	L		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	3

SALMAN KHAN	18	M	RTA	2	N	N	R	R	N		#NULL!	N	N	N	#NULL!	R	R	#NULL!	N	N	N	N	1
DARSHAN REDDY	22	M	FALL	3	N	N	R	R	R		#NULL!	N	N	N	#NULL!	N	R	#NULL!	N	N	N	N	2
RAMANNA	50	M	ASSAULT	1	R	N	N	N	R	R	18	N	N	N	22	N	N	#NULL!	N	N	N	N	3
SHIVARAJ PATIL	33	M	RTA	2	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	N	N	N	N	2
MARUTHI BABU	55	M	FALL	3	N	N	R	N	N		#NULL!	N	N	R	32	N	R	#NULL!	N	N	N	N	3
NARAYANA	22	M	RTA	2	R	R	R	R	N		#NULL!	N	N	R	30	N	N	#NULL!	N	N	N	N	2
KUMARASWAMY	37	M	RTA	2	N	N	L	N	N	L	9	N	L	L	24	N	L	#NULL!	R	N	N	N	2
LINGA REDDY	40	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	R	N	N	2
MOHAN KUMAR	30	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	R	N	N	2
RAAMAPPA	55	M	ASSAULT	1	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	3
AKASH	25	M	RTA	2	R	N	N	R	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	2
RAMACHANDRAIAH	55	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	3
ARUN KUMAR	20	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	1
SATISH	22	M	RTA	2	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	2
NAGAPRASAD	22	M	ASSAULT	1	R	N	N	N	N		#NULL!	N	N	N	#NULL!	N	N	#NULL!	R	N	N	N	2
NARAYANAREDDY	55	M	ASSAULT	1	N	N	R	N	R		#NULL!	N	N	N	#NULL!	N	R	#NULL!	N	N	L	N	3
DEVARAJAMMA	40	F	RTA	2	N	N	R	N	N		#NULL!	R	R	N	#NULL!	N	R	#NULL!	N	N	N	R	2
SHAFIULLA	28	M	RTA	2	N	N	R	R	N		#NULL!	N	N	N	#NULL!	N	R	#NULL!	N	N	N	R	2
SHANKARAPPA	50	M	RTA	2	N	N	R	R	N	R	17	N	R	N	24	N	R	#NULL!	N	N	N	R	3
JAGANATH	34	M	RTA	2	N	N	R	R	R	R	21	N	N	N	26	N	R	#NULL!	N	N	N	R	2