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COMPARISION OF HEARING IMPROVEMENT AFTER TYMPANOPLASTY AND TYMPANOPLASTY ALONG WITH CANALPLASTY. A CASE SERIES

KEYWORDS: Tympanoplasty, Canalplasty, middle ear, pure tone audiogram, hearing threshold.

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ABSTRACT

Background and objectives: *Tympanoplasty is the most common surgical procedure performed for middle ear pathology. It is done to clear the disease from the middle ear cleft, to close the perforation of tympanic membrane and to improve the hearing. Canalplasty is done to widen the bony external auditory canal as a part of Tympanoplasty. This study was conducted to compare the hearing improvement following Tympanoplasty alone and Tympanoplasty along with Canalplasty.*

MATERIALS AND METHODS: *This is a comparative, retrospective, longitudinal and double blind study with 200 patients. All are having chronic suppurative otitis media(CSOM), inactive, mucosal type with central perforation. All the patients were divided into 2 groups, 100 patients in each group. Preoperative and postoperative assessment done both clinically and audiologically. All patients underwent surgery under general or local anaesthesia, postauricular approach, temporalis fascia graft and underlay technique. Group 1 patients underwent Tympanoplasty alone and group 2 patients underwent Tympanoplasty along with Canalplasty.*

RESULTS: *Hearing improvement in two groups was assessed by clinical and audiological examination, pre and post operative audiograms compared. Average hearing improvement in group 1 is 16.3db and Average hearing improvement in group 2 is 21.9db.*

CONCLUSION: *Analysis of results revealed that Tympanoplasty along with Canalplasty is more beneficial to the patient as it resulted in more hearing improvement than Tympanoplasty alone.*

INTRODUCTION: CSOM is the most common ear disease in developing countries causing hearing loss. The factors influencing the high incidence are low socioeconomic status, poor hygiene, poor educational levels and improper primary health care facilities. Mucosal type is having an incidence of about 90-95%, and squamosal type 5-10% of CSOM cases.

Tympanoplasty is the most common surgical procedure performed in CSOM, mucosal type with central perforation. The goal of Tympanoplasty is to eradicate disease from the middle ear, to restore sound pressure transformation at the oval window, by coupling an intact tympanic membrane with mobile stapes foot plate via an intact or reconstructed ossicular chain and to provide sound protection for the round window membrane by a closed, air containing mucosa lined middle ear. The primary function of the external auditory canal is conduction of acoustic energy to the tympanic membrane. The canal has a resonance frequency of 2000-3000hz, which may facilitate conductance of frequencies helpful for speech discrimination. The most important factors in sound conduction are volume of ear canal and width of the external auditory meatus.

Canalplasty is widening of bony external auditory canal. During Tympanoplasty, we do Canalplasty so that in one microscopic view all the tympanic membrane along with annulus is seen clearly for better placement and adjustment of the graft and also for a better post-operative follow up. Knowledge of anatomical relations of the bony external auditory canal are very important in performing useful and uncomplicated Canalplasty. Canal is related anteriorly to the temporo-mandibular joint and parotid gland, posteriorly to mastoid air cell system, superiorly to floor of the middle cranial fossa, inferiorly to parotid gland. Vertical segment of facial nerve, in its lower part, lies just lateral to the fibrous annulus and is at risk during canalplasty in posteromedial part of bony canal.

Therefore this study is conducted to compare and analyze hearing improvement following Tympanoplasty alone and Tympanoplasty along with Canalplasty in patients with tubo-tympanic disease with central perforation.

MATERIALS AND METHODS:

Study type: This is a retrospective, longitudinal, analytical and comparative study.

Study settings: This study was conducted at Alluri Sitaramaraju Academy of Medical Sciences, Eluru, West godavari district, Andhra Pradesh, India from june 2013 to June 2016.

Inclusion criteria: patients with age between 15-55 yrs with inactive tubotympanic CSOM with central perforation.

Exclusion criterion: childrenless than 15 years of age (recurrent URTI), more than 55 yrs (to rule out the probable effect of poor cochlear reserve), atticoantral disease, recurrent CSOM and active CSOM.

Study design: All patients are divided into two groups randomly.

Group 1: 100 patients, 40 males, 60 females, treated with Tympanoplasty only

Group 2: 100 patients, 36 males, 64 females, treated with Tympanoplasty along with Canalplasty

PROCEDURE: All patients are informed and consent taken. All patients are examined by otoendoscopy, examination under microscope and puretone audiometry. Pure tone audiogram performed 7 days prior to surgery. The air and bone conduction thresholds were recorded in both pre and postoperative period. The air conduction and bone conductionthresholds are calculated by taking average of 500, 1000 and 2000Hzfrequency threshold. The air bone gap is the difference in thresholds ofair and bone conduction.c All patients operated under general or local anaesthesia, standard postauricularwilde's approach, temporalis fascia graft and underlay-technique. For canalplasty, standard postauricular wilde's incision, after harvesting temporalis fascia graft, horizontal meatotomy done at bonycartilagenous junction.

Canal incisions are given at 12'0 clock and 6'0clock position,posterior

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meatal flap elevated upto tympanic annuluswithout elevating the fibrous annulus. Catgut aluminium foil or silastic sheet was used to prevent injury to posterior meatal flap from running diamond burr.

Canal skin is very important for postoperative epithelialization. so it should be preserved as much as possible and as intact as possible. Posterior bony wall is drilled with 4 mm diamondburr, uniformly starting from lateral to medial. Henle' s spine drilledaway. Posterior bony wall is made uniform, smooth and wide. Inferomedially near the bony annulus, vertical segment of the facial nerve is just lateral to the bony annulus. We should prevent injury to the facialnerve. If there is anterior canal bulge, obscuring the view of anterior annulus, anterior wall has to be widened.

Medially based flap is raised giving canal incisions as per the narrowing and meatal flap elevated upto annulus and anterior bony canal drilled using 4mm diamond burr. At the end of canalplasty, tympanic membrane should be visible clearly upto the annulus level in one microscopic view.

Then fibrous annulus is elevated, middle ear entered and examined for status of middle ear, mucosa and continuity of ossicular chain. Graft placed by underlay technique. Middle ear and external auditory canal filled with gelfoam impregnated with antibiotic steroid drops. In canalplasty cases, lateral lip of horizontal meatotomy is sutured onto the mastoid periosteum so that bony cartilagenousjunction is widened. Postaural incision closed in layers. Mastoid bandage applied.

All cases are treated with broad spectrum systemic antibiotics for 2 weeks, antihistaminics for 1 month. Antibiotic steroid ear drops started after removing sutures from day 7. Pure tone audiogram done after 2 months of surgery in all cases.

In group one, 4 cases had long process of incus necrosis, and ossiculoplasty done by membrano-stapes assembly. In group 2 there is long process of incus necrosis in 6 cases and ossiculoplasty done by malleus stapes assembly. Cortical mastoidectomy done in 12 cases in group 1 and 15 cases in group 2.

Statistical analysis	Age of the patients in groups	
Age of the patient in years	Group 1	Group 2
Less than 20 years	25	22
21-30 years	34	38
31-40 years	23	23
Above 40 years	18	17

Pure tone hearing threshold(air conduction):

hearing threshold (in db)	Group 1 Pre operative	Post operative	Group 2 Pre operative	post operative
Less than 20 db	0	54	1	59
21-30db	16	33	17	35
31-40db	44	13	40	6
41-50db	24	0	27	0
51-60db	16	0	16	0

Pure tone audiometry air bone gap:

Air bone gap in db	Group 1 Pre operative	Post operative	Group 2 pre operative	Post operative
0-10 db	10	38	11	44
10-20db	26	56	32	50
20-30db	36	6	32	6
30-40db	24	0	21	0
40-50db	4	0	4	0

RESULTS: All patients hearing levels are analysed. Average preoperative hearing threshold in group 1 is 38.6db and in group 2 it is 40.4db. Post operative audiogram 2 months after surgery, average hearing threshold in group 1 is 22.3db and in group 2 it is 18.5db. So at the end of two months after surgery, hearing improvement in group 1 is 16.3db and in group 2 it is 21.9db. The difference in hearing improvement in two groups is 5.6db which is statistically significant. In group 1 there is residual perforation in 6 cases and in group 2, only in 3 cases.

DISCUSSION: CSOM tubotympanic type, inactive with central perforation, treatment of choice is Tympanoplasty. It is the most common surgical procedure performed in middle ear. It can be defined as surgical procedure where disease is cleared of the middle ear cleft, along with closure of tympanic membrane perforation and reconstruction of hearing mechanism.

The degree of hearing improvement after tympanoplasty depends on site and size of the perforation, ossicular status, status of middle ear mucosa, surgical technique, type of graft and function of Eustachian tube. The aim of tympanoplasty is to achieve an intact neotympanum with normal hearing acuity. Many modifications are performed to achieve this goal. Canalplasty is one such procedure.

The tympanoplasty technique and principles were described by Wullstein and Zollner in 1956. Heerman used temporalis fascia for the first time in tympanoplasty in 1861. Berthold described underlay technique in 1878. The present study was conducted on 200 patients suffering from CSOM tubotympanic disease. All patients in group 1 were treated by Tympanoplasty alone using temporalis fascia graft and underlay technique. All patients in group 2 were treated with Tympanoplasty along with Canalplasty using temporalis fascia graft and underlay technique.

The objective of the study was to compare hearing improvement following Tympanoplasty alone and Tympanoplasty along with Canalplasty. Variations of anatomy of external auditory canal like bony overhangs, stenosis, tortuosity etc impede the view of the tympanic membrane. Even with manipulation of microscope and patients head, sometimes margins of the perforation are not well delineated.

Canalplasty helps to remove the distortion in the canal and improves the view of operative field. After the completion of canalplasty all the tympanic membrane can be seen clearly in one microscope position including anterior annulus for better placement and adjustment of graft. Wide external auditory canal receives more vibrations and resonates well. Post operative cleaning will be good and easy.

The hearing result is best evaluated by the percentage degree of closure of AB gap when calculated as percentage. Wang et al, and collins et al reported closure of A-B gap, in 90% of cases treated with Tympanoplasty along with canal plasty and 83% following treatment by Tympanoplasty alone in their studies. In a study comparing 100 cases of Tympanoplasty alone and 100 cases of Tympanoplasty along with Canalplasty, vijayendra et al, achieved a 9 db better improvement in hearing in cases of canalplasty.

Our study achieved approximately 5.6 db between the two groups which is statistically significant. The annulus should be visualised all around in one view of microscope. Taneja reported an increase of graft uptake upto 91.3% in cases when canalplasty was combined with Tympanoplasty.

Thermal injury transmitted from the burr may cause delayed transient facial paralysis. But in our series there is no incidence of facial paralysis. Graft uptake rate also increased in many studies when canalplasty combined with tympanoplasty when compared to tympanoplasty alone. Different studies reported about 6-10% increase in graft uptake rate. Ajay mallick et al, 8% better graft take up rate, Taneja reported an increase of graft uptake upto 91.3% in cases when canalplasty was combined with tympanoplasty.

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CONCLUSION: Canalplasty helps in better visualisation, placement and adjustment of the graft during tympanoplasty. It prevents lateralisation of graft, due to accurate exposure of the annulus. Post operative care of the canal is also easier in cases of canalplasty. Canalplasty along with tympanoplasty gives better hearing improvement than tympanoplasty alone.

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