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Original Research Article

A study to evaluate bone and cartilage ossiculoplasty in patients of ossicular disruption due to chronic suppurative otitis media

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ABSTRACT

Background: Ossiculoplasty for ossicualar disruption in patients of chronic otitis media (COM) can be done by using either bone or cartilage. The present study was planned to compare bone and cartilage ossiculoplasty in patients of ossicular disruption due to COM.
Methods: The prospective observational study was carried out in patients, who were admitted in the department of otorhinolaryngology of a tertiary care teaching hospital of Rajasthan during two years from November 2017 to November 2019. All patients with ossicular disruption due to COM and conductive hearing loss more than 40db were included in the study. Patients with sensorineural hearing loss were excluded from the study. Pure tone audiometry (PTA) was done before surgery. Hearing improvement was assessed 3, 6 and 12 months after surgery.
Results: In the present study 20 patients underwent bone ossiculoplasty using autologous incus and autologous cartilage was used in 80 patients for ossiculoplasty. Post-operative hearing gain was significantly more in autologous incus patients (22.7±4.2 db) compared to autologous cartilage (19.5±3.4 db) (p=0.002).
Conclusions: The present study concluded that post-operative hearing gain was significantly better with autologous incus compared to autologous cartilage although both showed good results in terms of hearing gain.

Keywords: Chronic otitis media, Ossiculoplasty, Autologous incus, Pure tone audiometry

INTRODUCTION

In a civilized society, communication by speech is essential to survival. Radio, television, telephone are all an intimate part of our everyday life. A person with hearing loss is deprived of vital communication and is severely handicapped when competing in the present-day industrial world. It results in failure of academic achievement and hampers social and emotional development. In adults it produces psychosocial complications and affects the quality of individual's daily activity. They have reduced mobility, fewer interpersonal contacts and it poses a significant economic burden, as few deaf people are employed in professional, technical and managerial positions.[1]

Chronic otitis media (COM) is typically a persistent, potentially dangerous disease often capable of causing severe destruction and irreversible sequelae such as fatal intracranial complications leading to undue burden on the patient, family and society.[2] COM associated hearing loss is significant in our society and an effort directed towards the assistance of those who are afflicted is indeed worthwhile. The consistent achievement of good hearing acuity in presence of COM is still one of most difficult challenges of otologic surgery.[3,4] The debate as to whether the open techniques of mastoidectomy with tympanoplasty are better or worse than the closed techniques will continue. There is no alternative to the meticulous exenteration of disease and the operation of choice must be that which can achieve it. Once this is achieved the surgeon can decide on the type of middle ear

and/or mastoid reconstruction to be used, whether this should be staged or not, and what reconstruction should ultimately be achieved.

The consequences of surgical decision can be appreciated only over time, through the proper study of surgery done and its outcome and therefore each surgeon should analyse his/her results continuously and in relation to the principles used in his surgical problem solving. The problem of ossicular reconstructions in difficult chronic ears however continues to pose a major rehabilitation challenge.

The multiplicity of surgical options employed, and array of prosthetic alternatives would seem to underscore the magnitude of problem, as well as lack of consistent studies on it and lack of consistent success in dealing with it. Most of the studies have concentrated on a single technique, or on using a particular graft in their studies and have shown quite variable results. The ear nose and throat surgeon is still plagued with indecision over the type of surgery to be done, type of graft to be selected, and the type most suitable for the poor and low socioeconomic population, when he confronts the problem of ossicular reconstruction.[5] Hence the present study was undertaken to evaluate bone and cartilage ossiculoplasty in patients of ossicular disruption due to COM in terms of hearing gain after ossicular reconstruction.

METHODS

The prospective observational study was carried out inpatients, who were admitted in the department of otorhinolaryngology of a tertiary care teaching hospital of Rajasthan during two years from November 2017 to November 2019. All patients with ossicular disruption due to COM and hearing loss more than 40 db were included in the study. Patients with sensorineural hearing loss were excluded from the study. Informed consent was taken from all the patients and study was approved by institutional ethics committee.

Procedure

History of all the patients was taken to determine the onset, duration and cause of the hearing loss. Then the ears were examined under microscope to study the status of middle ear and external ear. The patients were planned for mastoid surgery. Routine investigations, relevant radiological investigations, tuning fork tests and pre-operative and postoperative pure tone audiometry (PTA) were done in all the patients. The patency of eustachian tube was established by asking the patient to perform Valsalva and Toynbee's manoeuvres. Homologous conchal and tragal cartilage and homologous ossicle (incus) was used for ossicular reconstruction.

After surgery sutures were removed on 7th day. Every patient was evaluated in an outpatient setting at 15 days, one month, one and half months, two and three months post-operatively. On every visit patients were asked about their subjective improvement in hearing and watched for the development for any complications. PTA was done at third post-operative month on every patient. PTA was done before surgery and post operatively after 3, 6 and 12 months. Once the data entry was completed, statistical analysis was carried out using Microsoft excel office 365. The data was presented as number (percentage) or mean±standard deviation wherever appropriate. Suitable statistical test was used to analyze the data. P value <0.05 was considered significant.

RESULTS

100 patients were analyzed during the study period of two years. In the present study maximum numbers of patients (54%) belong to 15-25 years. There were 60% females and 40% males in our study (Table 1).

Table 1: Age-sex wise distribution of study subjects (n=100).

Age group (years)	Sex (%)		Total (%)
	Male	Female	
<15	08 (20)	08 (20)	16 (16)
15–25	22 (55)	32 (53.3)	54 (54)
26–35	04 (10)	12 (20)	16 (14)
>35	06 (15)	08 (13.3)	14 (14)
Total	40 (40)	60 (60)	100 (100)

Ear discharge was commoner in right ear (56%) than left ear (26%) in our study and 18% had bilateral ear discharge. In the present study 68% right ears were operated and 32% left ears were operated.

In the present study most common symptom was ear discharge (100%) followed by hearing impairment (52%) and tinnitus (14%). 92% patients had no complications. In the tympanic membrane, subtotal perforation (28%) was most common and least common was marginal perforation (2%). In this study incus was most commonly involved ossicle (94%) and malleus (26%) was least commonly affected. Long process and lenticular process of incus (48%) were most commonly affected and the malleus head (2%) was least commonly affected. 8% patients were affected by tympanosclerosis and 38% of patients presented with cholesteatoma and 54% of patients presented with granulation tissue in mastoid and middle ear exploration. Sclerotic mastoid was most common (46%). Least common was pneumatic (18%) (Table 2).

In the present study, 20 patients underwent ossiculoplasty using autologous incus and autologous cartilage was used for ossiculoplasty in 80 patients. Post-operative hearing gain (22.7 db) was significantly more in autologous incus group compared to autologous cartilage (p=0.002). Canal wall up mastoidectomy with ossiculoplasty gave significantly more hearing gain (18.62 db) compared to canal wall down mastoidectomy with ossiculoplasty (17.7

db) and tympanoplasty with ossicular chain reconstruction (13.63 db) (p=0.026) (Table 3).

Table 2: Distribution of study patients with different parameters (n=100).

Distribution	Frequency	Percentage
Ear involved		
Right	56	56
Left	26	26
Bilateral	18	18
Ear operated		
Right	68	68
Left	32	32
Ear complaints		
Tinnitus	14	14
Ear discharge	100	100
Hard of hearing	52	52
Earache	16	16
Itching	22	22
Complications		
Lateral sinus thrombosis	02	02
Post auricular abscess	04	04
Facial palsy	02	02
No complications	92	92
Tympanic membrane		
Atticretraction	22	22
Subtotal	28	28
Central	24	24
Marginal	2	2
Post. superior retraction	24	24
Ossicles involved		
Malleus	26	26
Incus	94	94
Stapes	30	30
Parts of ossicles involved		
Long process of incus	48	48
Incus	46	46
Head of stapes	26	26
Malleus	16	16
Malleus handle	08	08
Anterior crus of stapes	04	04
Malleus head	02	02
Tympanosclerosis		
Present	08	08
Absent	92	92
Cholesteatoma		
Present	38	38
Absent	62	62
Granulation tissue		
Present	54	54
Absent	46	46
Mastoid pneumatization		
Sclerotic	46	46
Pneumatic	18	18
Diploic	36	36

Table 3: Comparison of material used/procedure done and improvement in hearing.

Parameters	Hearing improvement (db)		
	Numb-er	Mean±SD	P value
Material used			
Autologous Incus	20	22.7±4.8	0.002*
Autologous cartilage	80	19.5±3.4	
Procedure done			
Canal wall down mastoidectomy with ossiculoplasty	50	17.7±5.23	
Canal wall up mastoidectomy with ossiculoplasty	40	18.62±4.82	0.026*
Tympanoplasty with ossicular chain reconstruction	10	13.63±5.8	

*significant

DISCUSSION

Smyth (1980) observed that the overall objective of the treatment of COM in children is to ensure functional restoration by surgery with minimal delay and treatment of any upper respiratory problems, so that normal development of speech continues especially in bilateral disease.[6] The present study has compared bone with cartilage ossiculoplasty in patients of ossicular disruption due to COM.

In the present study sclerotic mastoid was most common (46%) followed by pneumatized (18%) and diploic (36%).These values were similar to the study of Royet al in which mastoid was pneumatized in 1.92%, diploic in 19.23% and sclerotic in 78.85% ears.[7] Most of the diseased ears demonstrated non-pneumatized mastoid (98.08%) whereas contralateral mastoid showed significantly more pneumatization (42.86%). This difference was statistically significant (p<0.0001).

In our study, incus was affected in 94% cases followed by stapes (30%), and malleus (26%). Long and lenticular process (48%) were the most common involved followed by complete incus erosion (46%), head of stapes (26%), and malleus head (2%). These values were similar to the study of Shrama et al which showed the malleus was eroded in 24% cases in group I out of which 14% had eroded handle of malleus and 10% had eroded lateral process.[8] In group II, malleus was eroded in 14% having erosion of handle in 6%, lateral process in 4% and both in 4%. The most commonly eroded ossicle was incus, 66 % in group I and 86 % in group II. Group I showed erosion of long process alone in 34% and long process with short process/body in 32%. Group II showed erosion of long process alone in 60% and long process with short process/body in 26%. Stapes was eroded in 40% in group I and 30% in group II. In group I all the cases of eroded

stapes had erosion of head and neck with crura while in group II, 12% had head and neck erosion and 18% had head and neck with crura eroded.

The results of tympanoplasty are frequently reported in terms of closure of air bone gap. Smyth and Patterson et al concluded that for significant benefit to be achieved, the post-operative air conduction average over the speech frequencies must be less than 30 db or the interaural difference reduced to less than 15 db.[9] This figure of 15 db corresponds to the cross-attenuation effect of skull.

In the present study, criterion for success was closure of air bone gap to 20 db or less post-operatively. This was similar to all other studies like Panda et al.[10] In our study subjective improvement of patients and hearing gain were included.

In this study, canal wall up mastoidectomy with ossiculoplasty (18.62 db) gave significantly better results compared to canal wall down mastoidectomy with ossiculoplasty (17.7 db) in terms of mean hearing gain. Chavan et al showed that mastoidectomy affects the outcome of ossiculoplasty, with both canal-wall-up and down mastoidectomy providing poorer results than no mastoidectomy.[11] The outcome was poorer in canal-wall-up mastoidectomy than canal-wall-down mastoidectomy. This may be probably due to the smaller number of cases undergoing canal-wall-up mastoidectomy as compared with canal-wall-up procedures.

Cook et al had showed that modified radical mastoidectomy (MRM) provides relatively safe surgical access for the removal of chronic middle ear and mastoid disease and gives reproducible results.[12] However, it had been suggested that hearing may not be as good as that after "intact canal wall mastoidectomy" (ICWM). This paper reviews 153 tertiary referrals suffering from extensive disease who underwent MRM and compares their hearing results with those obtained by other authors using ICWM and MRM and a variety of reconstructive techniques. Hearing results after MRM were found to be better after primary surgery than after revision and better in the presence of an intact stapes. No significant differences were found between hearing results obtained by MRM in our study and other published results of canal wall down mastoidectomy and ICWM, irrespective of the type of ossicular replacement.

In our study post-operative hearing gain with autologous incus is 22.7 db and 19.5 db with autologous cartilage. In a study by Mahanty et al cartilage had 60% success rate, incus had 73.68%, and partial ossicular replacement prosthesis (PORP) had 56.25% success.[13] They concluded that among the ossiculoplasty materials, autologous incus gives best postoperative hearing gain and lowest extrusion rate.

In the study by Tushar et al, group A underwent ossicular reconstruction using allograft (teflon), group B underwent ossicular reconstruction using autograft (tragal cartilage) and group C underwent ossicular reconstruction using autograft (autologous bone).[14] They found that reconstruction with bone was superior than cartilage and cartilage had better post-operative outcomes than teflon group with respect to post-op hearing threshold, closure in air bone gap, hearing improvement. Similar results were found by Ojala et al.[15] Quaranta et al also proposed costal cartilage as material of choice when autologous ossicles are not available.[16]

Prasad et al conducted a retrospective study to compare and analyse the outcome of ossiculoplasty with autologous incus and autologous cortical bone.[17] They concluded that there was no significant difference in the outcomes following ossiculoplasty with autologous incus or autologous cortical bone in terms of graft uptake rates, the formation of retraction pockets, recurrence rates and hearing improvements. The present study also showed better hearing gain in autologous incus (22.7 db) than cartilage (19.5 db). Hearing improvement after ossiculoplasty was also found to be better with bone than with cartilage in Rout et al who found hearing gain was 33.34 db with bone whereas with cartilage it was 29.34 db.[18]

CONCLUSION

The present study concluded that post-operative hearing gain was significantly better with autologous incus compared to autologous cartilage although both showed good results in terms of hearing gain.

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