



HEARING REHABILITATION BY DOUBLE CARTILAGE BLOCK OSSICULOPLASTY IN MICRO EAR SURGERY

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Pradeep Kumar Gupta

Assistant Professor, Department of ENT, MDBASMC Deoria

Pramod Kumar Yadav

Associate Professor, Department of ENT, MRAMC Ambedkar Nagar

Chandra Bhan

Assistant Professor, Department of ENT, MRAMC Ambedkar Nagar

Sushil Kumar Sharma*

Assistant Professor, Department of ENT, MRAMC Ambedkar Nagar *Corresponding Author

ABSTRACT

Introduction: Ossiculoplasty is frequently used in the treatment of conductive hearing loss. The double cartilage block ossiculoplasty offers several advantages like it is easy to perform, uses well tolerated autologous materials, and has no additional cost. **Objectives:** The purpose of our study is to assess the results of hearing reconstruction by double cartilage technique in case of chronic ear disease. **Materials and Methods:** The prospective randomized study was conducted in the department of ENT, GSVM Medical College, and Associate LLRM Hospital from January 2017 to October 2019 on patients, admitted from casualty and outpatient's department with a diagnosis of chronic suppurative otitis media. Patients between 12- 60 year of age having history of chronic ear discharge with minimum air bone gap of 20 dB, and only those cases of chronic otitis media with ossicular erosion of incus and stapes superstructure were included in the study. Revision cases and patient with sensorineural hearing loss were not included in study. **Result:** Preoperatively mean air bone gap was found to be 40.76 dB while mean air bone gap after surgery has improved to 21.42 dB Comparison of AB gap showed highly significant improvement in hearing loss postoperatively as suggested by the p value. **Conclusion:** DCB ossiculoplasty is easy to perform and also found to be low cost and tolerance is excellent. It was found that there is significant improvement in hearing after surgery.

KEYWORDS

double cartilage ossiculoplasty, conducting hearing loss, chronic ear disease, ossicular erosion.

INTRODUCTION

The ossicles (also called auditory ossicles) are three bones in either middle ear that are among the smallest bones in the human body. They serve to transmit sounds from the air to the fluid-filled labyrinth (cochlea). The absence of the auditory ossicles would constitute a moderate-to-severe hearing loss [1].

Ossiculoplasty is frequently used in the treatment of conductive hearing loss. It is reconstruction of the middle ear ossicular chain which has been disrupted or destroyed, by the use of some interposition devices which helps in regaining the original mechanics of the ossicular chain to transfer the sound energy to the inner ear as ossicles serve as an acoustic transformer to match the impedance of the air to the much higher impedance of the cochlear fluids. Middle ear apparatus besides providing physical protection for cochlear fluids also serve to couple sound preferentially to only one window of the cochlea, thus producing a differential pressure between the windows, required for the movement of the cochlear fluids.

The double cartilage block ossiculoplasty for partial ossicular reconstruction in the presence of an intact stapes was described in 1987 by Luetje and Denninghoff [2]. This technique offers several advantages- it is easy to perform, uses well tolerated autologous materials, and has no additional cost. Despite those advantages and encouraging hearing results, this interesting ossiculoplasty technique is not very popular among otologists.

Methodology

A rectangular block of tragal cartilage is obtained. The surgeon judges the size fitting on the single case. The perichondrium is left on both cartilage sides, The cartilage is cut in half (illustration A), avoiding transecting the perichondrium on the opposite side Next, the perichondrium is stripped off only from the side of cartilage that will be placed on the stapes, leaving intact the perichondrium on the side that will be in contact with the tympanic membrane (illustration B).

A shallow acetabulum is created in 1 leaf to accept the stapes capitulum, strengthening stabilization of the implant (illustration C). The cartilage is then folded on itself, with the intact perichondrium layer doubled between the 2 cartilage blocks (illustration D). This acts as a hinge that keeps the blocks from s lipping. The DCB is placed between stapes and tympanic membrane.

The purpose of our study is to assess the results of hearing

reconstruction by double cartilage technique in case of chronic ear disease. For several years this technique has been routinely used at our institution, and it is commonly referred as cartilage ossiculoplasty from stapes to tympanic membrane (COST). It was decided to evaluate the results of this technique in a prospective randomized case- control study and to compare with published studies about partial other ossicular chain reconstruction techniques. Hence the study was undertaken with the following objectives:

1. To reconstruct the ossicular chain by double-cartilage block (DCB) ossiculoplasty.
2. To study the hearing results after double cartilage block ossiculoplasty.
3. To compare the results with previous studies.

MATERIALS AND METHODS

The prospective randomized study was conducted in the department of Ear, Nose & Throat, GSVM Medical College, and Associate LLRM Hospital from January 2017 to October 2019 on patients, who were admitted from casualty and outpatient's department with a diagnosis of chronic suppurative otitis media. Patients between 12- 60 year of age having history of chronic ear discharge with minimum air bone gap of 20 dB, and only those cases of chronic otitis media with ossicular erosion of incus and stapes superstructure were included in the study. Cases with sensory neural hearing loss and Cases with complication of chronic suppurative otitis media were excluded from the study. Data was collected in predesigned and pretested proforma of proposed study. Approval has also been taken from the ethical committee.

Socio- economic status, Family history, Personal history, Past history (Previous history of TB, diabetes mellitus, hypertension) were inquired from patients before study. General examination like Pulse rate, Respiratory rate, Temperature, Blood pressure was done. Physical examination like Pallor, Icterus, Edema, Clubbing, and Cyanosis were also done during the study. Lymphadenopathy, Systemic examination, Local examination Investigation and Routine hemograms like CBC, LFT, KFT, RBS; Serum electrolytes like PT/INR, TUNING FORK TEST, PURE TONE AUDIOMETRY; Preop, Postop, Impedance audiometry, Radiological., HRCT temporal bone bilateral were tested and recorded during the study.

RESULT AND DISCUSSION

Total 50 patients were included in the study out of which 28(56%) were males, while 22 (44%) were females., 26 patients (52%) were in the age group of 10 - 20 years, 12 patients (24%) were in the age group 21 –

30 years. 09 patients (18%) were in the age group 31 – 40 years, 03 patients (6%) were in the age group 41 -50 years and 0 patients in the age group 51 – 60years.

Out of the 50 patients, 42 presented with otorrhea preoperatively. 0 out of 50 patients had otorrhea after the surgery. A total no of 40 patients (out of 50 patients) of attic cholesteatoma were included preoperatively in our study. Postoperative recurrence did not occur in any patient. 14 patients (out of 50 patients) reported with associated tinnitus preoperatively in our study which amounts to 28% of total patients. Post operatively, 2 of them reported with tinnitus, which was managed conservatively.

A total no of 10 (out of 50 patients) patients with a retraction pocket in the attic region were included preoperatively in our study. Post operatively, no patients reported with a recurrence of retraction pocket. A total no of 4 patients (out of 50 patients) with otalgia were included preoperatively in our study. Post operatively, no patients complained of otalgia.

A total no. of 4 patients (out of 50 patients) with post auricular fistula were included preoperatively in our study. Post operatively, no patients had post auricular fistula.

A total no. of 2 patients (out of 50 patients) with EAC Polyp were included preoperatively in our study. Post operatively, no patients came with recurrence of EAC polyp.

Preoperatively mean air bone gap was found to be 40.76 dB while mean air bone gap after surgery has improved to 21.42 dB. Comparison of AB gap showed highly significant improvement in hearing loss postoperatively as suggested by the p value.

DISCUSSION

As per the retrospective study by Harvey SA, et al, 23 patients underwent a canal wall down (CWD) tympano-mastoidectomy with double cartilage block (DCB) ossiculoplasty [3]. Age of patients under study ranged from 6 to 85 years (mean, 36.5 year) and audiometric results were available in 20 patients. The mean air- bone gap was 23.8 dB after surgery. Closure of the ABG to within 20 dB was achieved in 10 of 20 patients (50%).

According to the study undergone by Malafronte G, et al.2008 [4], ossicular chain reconstruction performed with modified double-cartilage block (DCB) ossiculoplasty leaving the inner perichondrium layer as the cartilage surface in contact with tympanic membrane results in significant hearing results and prevent DCB displacement and DCB loss of stiffness when compared with original DCB technique described by Luetje and Denninghoff. First group with 25 cases, received the original DCB ossiculoplasty tech. described by Luetje and Denninghoff. In the second group, 32 modified DCB ossiculoplasties were performed, the main follow- up for the whole study group was 7years. Successful rehabilitation (pure tone average air- bone gap <20 dB) of conductive hearing loss was obtained in 48 % of cases in group 1 (original DCB) and in 81.2% of cases in group 2 (modified tech.).

In a study conducted by Denis Ayache et al. the objective of this study was to report hearing results of cartilage interposition ossiculoplasty in one- stage intact canal wall (ICW) tympanoplasty for cholesteatoma with intact stapes study was retrospective [5]. A series of 81 patients were taken. In the preoperative period, the mean air conduction thresholds (AC), air bone gap and speech reception threshold (SRT) were 35.3, 20.14 and 35.6 dB respectively. Postoperatively with a mean follow- up of 29 months, AC, ABG and SRT were 27.8, 13.34 and 28.8dB respectively. Mean hearing gain was 6.8 dB and mean SRT improvement was 6.8 dB. Mean bone conduction threshold for 1,2 and 4 KHz remained stable after surgery (17.6 dB pre operatively vs 18 dB postoperatively).

Dornhoffer J (2003) [6] observed that cartilage tympanoplasty achieves good anatomical and autologic results when pathology and status of the ossicular chain dictate the technique utilized. Significant hearing improvement was realized in each pathological group. In the atelectatic ear, cartilage allowed us to reconstruct the TM with good anatomic results compared to traditional reconstructions, which have shown high rates of *retraction and failure. In cholesteatoma, cartilage tympanoplasty of the TM and helped reduce recurrence. In cases of high- risk perforation, reconstruction with cartilage favorably to

primary tympanoplasty using traditional techniques. We believe the indications for cartilage tympanoplasty (atelectatic ear, cholesteatoma, high- risk perforation) were validated by these results.

C. Querat et al (2014) [7] studied that in the surgical treatment of cholesteatoma by CWU tympanoplasty, when the stapes is preserved, the use of strips of cartilage positioned over the head of stapes to restore the columellar effect provides functional results similar to those of PORP and, in our opinion, should be preferred, as cartilage is easily available, totally biocompatible, easy to manipulate and does not incur any additional costs.

Karan Sharma (2016) [8] stated that ossicular discontinuity is the most common cause of conductive hearing loss. The use of ossicular graft material in ossicular chain reconstruction significantly improves the results in hearing. This study was conducted to compare and analyze the outcome of ossicular reconstruction using autologous septal cartilage in terms of hearing results and graft uptake rates. Study design Randomized clinical trial. Study included 100 patients visiting the ENT department of government medical college. Patients between 16 and 50 years of age with history of chronic ear discharge and minimum air bone gap of 20 dB were included in the study. The patients underwent detailed ENT examination, audiological and radiological assessment of temporal bone and those patients with evidence of ossicular erosions were subjected to ossiculoplasty with autologous conchal cartilage (group 1) and homologous septal cartilage (group 2) randomly. The patients were followed up after 3 and 6 months to analyze functional and anatomical results. Out of 50 patients from group 1 who underwent autologous cartilage ossicular reconstruction 35 patients (70%) showed significant improvement in hearing as assessed by pure tone audiogram after 6 months as compared to 34 patients (68%) with homologous cartilage reconstruction. Complications and extrusion rates were almost similar in both the groups. Hearing results but the homologous preserved cartilage being readily available is an equally good option for ossicular reconstruction.

Jerome Nevoux et al (2010) [9] assess the efficiency of partial ossicular chain reconstruction using autologous cartilage in tertiary academic children's hospital. 268 children ears underwent partial ossicular chain reconstruction using a shaped block of tragal cartilage interposed between the head of the stapes and an underlay tympanic membrane reconstruction along with tragal cartilage and its perichondrium. Mean age at surgery was 10.9 years. Single- stage surgery was performed in 124 ears (46.3%) (62.9% for cholesteatomas and 32.3% for retraction pockets). Second- look patients (53.7%) included 93.8% of staged surgery. Audiometric results were available for 222 ears at 1 year and for 78 ears at 5 years. Closure of the average air- borne gap (ABG) to within 20 dB was achieved in 62.2% of ears at 1 year.

The mean (SD) pre- operative and 1- year postoperative ABGs were 25 (11.8) dB and 18.9 (10.3) dB, respectively. Anatomical results were satisfactory in 87.3%. No cases of extrusion, resorption, or displacement of the cartilage were encountered. No statistically significant difference was found between audiometric results at 1 and 5 years. This method proved to be suitable for those cases which need open technique tympanoplasty. Harvey SA et al (1998) [10] ranged from 6 to 85 years (mean, 36.1 y). The majority of ears were actively draining at the time of surgery (83%) and most procedures were revisions of prior mastoidectomies (74%). Audiometric results were available in 20 patients. The mean air- bone gap (ABG) was 23.8 dB after surgery. Closure of the ABG to within 20 dB was achieved in 10 of 20 patients (50%). No cases of DCB extrusion have occurred to date. They concluded that the DCB represents an excellent alternative to biocompatible prostheses for ossicular reconstruction in the setting of severe chronic ear disease. As with all methods of ossiculoplasty, long- term follow- up will be necessary to determine if this technique remains stable in the hostile environment in which it has been employed.

Roshan Jalisatgi, et al. (2017) [11] studied to evaluate the hearing outcome in patients undergoing ossiculoplasty using autograft cartilage in canal wall down surgery for cholesteatoma. The retrospective study was conducted in a tertiary care hospital from January 2011 to January 2014. This study included 54 patients who underwent canal wall down mastoidectomy with tympanoplasty during this period. Preoperative and postoperative ABG for short columella were 23.13 dB and 12.66 dB respectively. Preoperative and postoperative ABG for long columella were 36.96 dB and 24.77 dB

respectively. The use of autologous cartilage in ossiculoplasty during canal wall down mastoidectomy gives excellent hearing gain. It is also a cheaper option which is financially feasible in developing countries.

Filosaetal (2019) described the outcomes of Malafronte's double cartilage block (DCB) and incus autograft prostheses. The partial columellar ossiculoplasties were performed on 102 patients. Malafronte's DCB was used on 58 patients (group 1). The reshaped autologous incus was used on 44 patients (group 2). Mean postoperative air- bone gap (ABG) closure to <20 dB, incidences of prosthesis availability, prosthesis displacement from the tympanic membrane, and prosthesis fixation to the middle ear walls. As a result, Malafronte's DCB gives more consistent hearing results.

CONCLUSION

Goals of surgical management of CSOM is eradication of disease, restoration of hearing and to an extent possible maintenance or restoration of a normal anatomical configuration. DCB ossiculoplasty is easy to perform and also found to be low cost and tolerance is excellent. It was found that there is significant improvement in hearing after surgery. Ear was also found to be free from discharge or residual diseases a recurrence of disease was also found rare. Long term hearing outcomes remains stable and satisfactory. Hence DCB represents an excellent alternative to biocompatible prosthesis for ossicular reconstruction in the setting of severe chronic otitis media. This technique has the advantage that it permanently removes the disease and preserve the hearing function. It also gives better quality of life with an improved hearing ability.

Table 1: Pre-operative And Post –operative Complications In Patients.

Complications	Pre- operative		Post – operative	
	No. of Patients	Percentage	No. of Patients	Percentage
Otorrhea	42	84	0	0
Attic cholesteatoma	40	80	0	0
Tinnitus	14	28	2	4
Retraction Pocket	10	20	0	0
Otalgia	4	8	0	0
Post auricular fistula	4	8	0	0
Eac Polyp	2	4	0	0

Table 2: The Mean Pre-operative And Post Operative Air Bone Gap In Patients (DB)

	Pre-Operative	Post-Operative	Difference	P value
Mean	40.76	21.42	19.33	0.001
± SD	7.45	9.29	8.57	

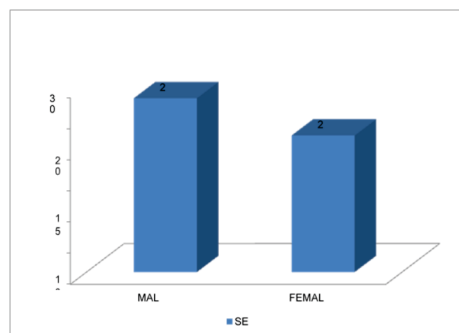


Figure1: Sex Distribution

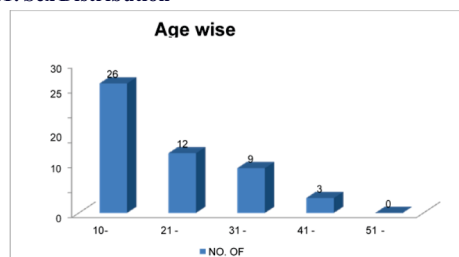


Figure:2 Age Distribution

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