Role of Autologous Versus Homologous Cartilage in Ossicular Reconstruction: A Comparative Study

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Abstract Ossicular discontinuity is the most common cause of conductive hearing loss. The use of ossicular graft material in ossicular chain reconstruction significantly improves the result in hearing. This study was conducted to compare and analyze the outcome of ossicular reconstruction using autologous conchal cartilage and homologous 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 erosion were subjected to ossiculoplasty with autologous conchal cartilage (group I) and homologous septal cartilage (group II) randomly. The patients were followed up after 3 and 6 months to analyze functional and anatomical results. Out of 50 patients from group I 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 in both the groups are almost comparable but the homologous preserved cartilage being readily available is an equally good option for ossicular reconstruction.

Keywords Ossicular reconstruction · Autologous conchal cartilage · Homologous septal cartilage

Introduction

Ossicular chain reconstruction is a challenging endeavor that is expected to result in significant improvement of conductive hearing loss [1]. Many factors affect the outcome of ossiculoplasty. Eustachian tube function, adhesions and the status of the residual ossicular chain are some of intrinsic factors, while the extrinsic factors are the surgical technique and the design and composition of the prosthesis used [2, 3]. Over the years, various grafts (autografts/allografts) have been used for ossicular reconstruction, like homograft and autograft ossicles, cartilage, alloplastic ossicular prostheses like Total or Partial Ossicular Replacement Prosthesis, ceramic implants, hydroxyapatite, bone cements, titanium, gold etc. were used [4]. Some studies have reported that equally good results maybe achieved with autograft, homograft or alloplastic partial prostheses [5]. In our study we have compared the results of ossiculoplasty by using autologous conchal cartilage and homologous septal cartilage and compared the outcomes of surgery in terms of graft take-up rates and hearing improvement postoperatively.

Materials and Methods

Patients in the age group between 16 and 50 years attending the E.N.T. outpatient department of Government medical College were included in the study. The inclusion criteria for the patients were those suffering from chronic

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otitis media with conductive hearing loss in the ear to be operated with a minimum definitive air bone gap of 20 dB. Patients who suffered from complications of CSOM, acute suppurative otitis media, otosclerosis were excluded from study. All the patients underwent detailed ENT examination followed by audiological and radiological assessment of temporal bone, and those patients with evidence of ossicular erosion were subjected to ossiculoplasty with autologous conchal cartilage (group I) and homologous septal cartilage (group II) randomly.

Compliance with Ethical Standards

All the authors declare that they have no conflict of interest. Ethical clearance was obtained from appropriate ethical committee for research on human subjects. Written informed consent was obtained from all the subjects using the standard consent form approved by the ethical committee.

Surgical Technique

The operation was done under local anaesthesia by postaural route in all cases. Autologous Conchal cartilage was procured from the patient intraoperatively and shaped accordingly. Similarly The Homograft Septal Cartilage was procured from vomero-chondrine groove during septoplasty and preserved in 70 % absolute alcohol. When cartilage was needed for reconstruction, it was washed in saline for one hour in the operating room. It was shaped using a 15 number blade such that the length just protrudes through the neotympanic membrane. Further the superior contact surface of the cartilage should be sloping to have enough contact area (at least 5² mm) and the margins made smooth so that there were no sharp edges against the tympanic membrane. If the Stapes head was present then the inferior portion of the cartilage was drilled using 0.6 mm diamond burr to form a socket for the stapes head and a groove for stapedius tendon was designed using 15 number blade. If the stapes head was absent then the inferior portion of cartilage was designed using 15 number blade such that the inferior part fitted into the footplate area without touching the adjacent facial canal or promontory.

After securing the temporalis fascia graft and tympanomeatal flaps in the anterior sulcus with underlay technique (in both closed and open cavity procedures), the temporalis fascia graft was gently elevated posteriorly till the oval window area was visualized. Placement of the cartilage graft depended on the presence or absence of stapes head. In cases where the stapes head was present, the graft was placed over the stapes head using a 22 gauge

suction cannula and smooth curved pick. The cartilage graft was placed between stapes and neo-tympanic membrane (temporalis fascia) such that the slanting head surface was stabilized under the temporalis fascia graft. After placing the cartilage graft; its stability over the stapes was confirmed. However if stapes head was absent, then after ascertaining the mobility of the stapes foot plate and round window reflex, a small rectangular piece of temporalis fascia was placed over the footplate and spread partially on the facial canal and promontory. The fascia cover helped to centre the cartilage graft and prevent its dislocation from footplate. It prevents bony ankylosis with promontory or facial canal. The shaped cartilage graft was placed between footplate and neo-tympanic membrane (temporalis fascia graft).

The cartilage graft was temporarily supported by gel-foam soaked in antibiotic eardrops. Care was taken to prevent contact between remodelled cartilage graft and surrounding structures (posterior bony rim, lateral attic wall, facial canal, promontory or conchal cartilage). The temporalis fascia graft was repositioned. The external auditory canal was filled with antibiotic solution and the cotton ball covered with antibiotic ointment kept over it.

Outcome Measures

Audiometric evaluation was done 3 and 6 months postoperatively, which included postoperative air-bone gap (ABG) using PTA and finally 6 month PTA values were taken for calculation. Anatomical results, that is, closure of tympanic membrane perforation, graft take up and retraction pockets were analyzed oto-microscopically.

Statistical Analysis

For different quantitative parameters, mean, median, and standard deviation (SD) were calculated. Student's *t* test (unpaired) was used to calculate the statistical significance between two groups (I and II).

Results

A total of 100 patients included in the study, 50 patients underwent ossiculoplasty with autologous conchal cartilage and 50 with homologous septal cartilage.

41 out of 50 patients who underwent ossiculoplasty with autologous graft had presented with conductive hearing loss and the remainder had mixed hearing loss. In the homologous graft group, 36 patients had conductive hearing loss while the rest had mixed type. In the autologous graft group, 90 % patients had Tubotympanic disease clinically while operatively 80 % had it. The remaining

had Atticoantral disease. In the homologous graft group, 94 % had Tubotympanic disease clinically while during the surgery it was found in 84 % patients.

Cortical mastoidectomy was performed in 80 % patients who underwent autologous grafts and 84 % of those with homologous grafts. Modified Radical Mastoidectomy was performed in 20 % in autologous and 16 % in homologous group. Malleus was found to be eroded in 24 % cases in group I out of which 14 % had eroded handle of malleus and 10 % had eroded lateral process. In group II, malleus was eroded in 14 % having erosion of handle in 6 %, lateral process in 4 % and both in 4 %. The most common ossicle which was found to be eroded was Incus in both the groups, 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 (Table 1).

Table 2 and Fig. 1 compare the hearing outcome of ossiculoplasty with autologous conchal cartilage (group I) and homologous septal cartilage (group II). Postoperative closure of air bone gap was 21–30 dB in 16 (32 %) patients in homologous group as compared to 15 (30 %) patients in group autologous conchal group. In group I maximum ABG was 28.6 dB, minimum was 7.4 dB and mean ABG

was 16.87 dB. In group II maximum ABG was 22.7 dB, minimum was 8 dB and mean ABG was 15.98 dB (Fig. 2).

No wound dehiscence, stitch abscess or persistent discharge was found postoperatively in either group. Graft extrusion rate with autologous conchal group was 6 % as compared with homologous septal in which it was 8 %.

Discussion

Loss of ossicular chain is the most common cause of conductive hearing loss in adults which can be managed. Various surgical techniques and materials have been used for ossicular chain reconstruction since 1950, but still there is no standardized technique and ideal material accepted worldwide.

Patients in the age group between 16 and 50 years suffering from chronic otitis media with conductive hearing loss attending E.N.T. outpatient department of Government medical College were included in the study. The minimum definitive air bone gap was 20 dB. The patients with evidence of ossicular erosion were subjected to ossiculoplasty with autologous conchal cartilage (group I) and homologous septal cartilage (group II) randomly.

41 out of 50 patients in group I had presented with conductive hearing loss and the remainder had mixed hearing loss. In group II, 36 patients had conductive hearing loss while the rest had mixed type. In another study 55.7 % cases had conductive hearing loss, while 27.7 % had mixed type [6].

Table 1 Ossicular status

Ossicle	Autologous (%)	Homologous (%)
<i>Malleus</i>		
Eroded	24	14
Handle	14	6
Lateral process	10	4
Handle and lateral process both	0	4
Not eroded	76	86
<i>Incus</i>		
Eroded	66	86
Long process alone	34	60
Long process with short process/body	32	26
Not eroded	34	14
<i>Stapes</i>		
Eroded	40	30
Head and neck only	0	12
Head and neck with crura	40	18
Not eroded	60	70

Table 2 Comparison of postoperative hearing results with autologous graft and homologous graft

Post operative AB closure gap (dB)	Homologous cartilage	Autologous cartilage
<10	12 (24 %)	15 (30 %)
10–20	22 (44 %)	20 (40 %)
>20	16 (32 %)	15 (30 %)

In our study 45 (90 %) patients had safe (tubotympanic) and 5 (10 %) had unsafe (Atticoantral) CSOM in Group I. However on surgical exploration 40 (80 %) were found to be safe and 10 (20 %) unsafe. In group II, 47 (94 %) patients had safe disease clinically while 42 (84 %) were found to have it during surgery. In another study 76 % patients had tubotympanic otitis media while 24 % had Atticoantral disease [7].

Cortical mastoidectomy was performed in patients found to have tubotympanic type CSOM and Modified

Radical Mastoidectomy was performed in those with atticoantral type CSOM.

Our study showed the Malleus to be eroded in 24 % cases in group I out of which 14 % had eroded handle of malleus and 10 % had eroded lateral process. In group II, malleus was eroded in 14 % having erosion of handle in 6 %, lateral process in 4 % and both in 4 %. The most common ossicle which was found to be eroded was Incus in both the groups, 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. Another study revealed that 97 % cases had ossicular erosion out of which the long process of incus was the

Fig. 1 Comparison of postoperative hearing results with autologous graft and homologous graft **Fig. 2** Comparison of subjective and objective hearing improvement in autologous and homologous groups

commonest to be involved followed by stapes, similar to our study which showed erosion of long process of incus was the most common [8].

In our study, the graft uptake rate was 94 % in group I and 92 % in group II. Another study showed an intact graft in majority i.e. 89.3 % of cases with better results in bone chip as compared to autologous cartilage [9].

The subjective Hearing improvement in our study was found to be 82 % in group I and 84 % in group II. Post operative ABG, indicative of the objective hearing improvement was <20 dB in 70 % cases in group I and 68 % in group II. This is in accordance with a study showing Postoperative ABG within 20 dB in 74 % at latest follow-up [10]. In another study by Sendra et al. [11] in which homologous cartilage was used for ossicular reconstruction, closure of the ABG to within 20 dB was achieved in 10 of 20 patients (50 %)

Conclusion

Overall Hearing results after ossiculoplasty with homologous septal cartilage were almost similar as compared with those obtained after autologous conchal cartilage. Complications and extrusion rate were also almost comparable. This indicates that ossiculoplasty with homologous cartilage offers a good alternative with minimal complications and extrusion rates. Moreover autografts have some disadvantages like lack of availability in chronically diseased ears, prolonged operation time to obtain and reshape the material and/or loss of rigidity. On the other hand homologous cartilage is easily available thus convenient for otologists. It is worthwhile to conclude that there is a need for many more clinical trials with a larger sample size and longer follow-up period to standardize the ossiculoplasty using homologous cartilage. Conclusion is that readily available homologous cartilage graft do compete with the well established choice of autograft cartilage and can be used for ossicular reconstruction with good results without any risk of complications.

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Compliance with Ethical Standards

Conflict of interest All the authors declare that they have no conflict of interest.

References

1. Merchant SN, Nadol JB Jr (1994) Histopathology of ossicular implants. *Otolaryngol Clin North Am* 27:813–833
2. Chaudhary N, Anand N, Laperwal A, Rai AR (2003) Role of autografts in the reconstruction of ossicular chain in the intact canal wall procedure. *Indian J Otolaryngol Head Neck Surg* 55:157–159
3. Jha S, Mehta K, Prajapati V, Patel D, Kharadi P (2011) A comparative study of ossiculoplasty using various graft materials. *NJIRM* 2(4):53–55
4. Athanasiadis-Sismanis A, Poe DS (2010) Ossicular chain reconstruction. In: Gulya AJ, Minor LB, Poe DS (eds) *Glasscock-Shambaugh surgery of the ear*, chap 29, 6th edn. Peoples medical publishing house, Connecticut, pp 489–501
5. Iurato S, Marioni G, Onofri M (2001) Hearing results of ossiculoplasty in Austin–Kartush group A patients. *Otol Neurotol* 22:140–144
6. Am Alabbasi, Alsaimary IE, Najum JM (2010) Prevalence and patterns of chronic suppurative otitis media and hearing impairment in Basrah city. *J Med Med Sci* 1(4):129–133
7. Adhikari P, Joshi S, Baral D, Kharel B (2009) Chronic suppurative otitis media in urban private school of Nepal. *Braz J Otolaryngol* 75(5):669–672
8. Salman AA, Azhar H, Muhammed EK, Muhammad M (2009) Analytical study of ossicular construction in middle ear cholesteatoma. *Annals* 15(3):134–137
9. Gajjar Y, Aiyer R (2010) Hearing results—ossiculoplasty using autologous materials. *Guj J Otorhinolaryngol Head Neck Surg* 7(1):25–27
10. Martin TP, Weller MD, Kim DS, Smith MC (2009) Results of primary ossiculoplasty in ears with an intact stapes superstructure and malleus handle: inflammation in the middle ear at the time of surgery does not affect hearing outcomes. *Clin Otolaryngol* 34(3):218–224
11. Harvey SA, Lin SY (1999) Double cartilage block ossiculoplasty in chronic ear surgery. *Laryngoscope* 109(6):911–914