Relevance of Pure Tone Average (PTA) as a Predictor for Incus Erosion

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Abstract Between 40 and 90% of tympanoplasty require middle ear ossicular chain reconstruction. Ossicular discontinuity usually cannot be determined unless an operation is performed. The main objective was to determine the predictive value of pre-operative audiological factors in diagnosing incudal necrosis in patients with tubotympanic chronic suppurative otitis media. A retrospective clinical study of 20 patients who underwent ossicular reconstruction with autologous incus over a period of two years was performed. The mean pre-operative pure tone average was 49.18 dB HL. The minimum value being 45 dB HL and the maximum value being 64 dB HL.

Keywords PTA · Incus erosion · Autograft · Ossiculoplasty

Introduction

Between 40 and 90% of tympanoplasty require middle ear ossicular chain reconstruction [1]. Ossicular reconstruction was first performed in the 1950's. In cases with intact stapes but defective incus and/or malleus, type II and III tympanoplasties were the choice of ossiculoplasty according to the Wullstein classification in 1956 [2, 3]. Ossicular discontinuity usually cannot be determined unless an operation is performed.

Objective

To determine the predictive value of pre-operative audiological factors in diagnosing incudal necrosis in patients with tubotympanic chronic suppurative otitis media (CSOM).

Materials and Methods

Study Design

A retrospective clinical study of 20 patients who underwent ossicular reconstruction with autologous incus over a period of two years was performed.

The following inclusion and exclusion criteria were used.

Inclusion Criteria

Patients between the age group of 12–60 years diagnosed to have CSOM—Tubo-tympanic Disease quiescent stage/inactive stage (unilateral/bilateral) were included in the study. Patients with conductive hearing loss, along with good cochlear reserve and good eustachian tube function as evidenced by diagnostic nasal endoscopy were included.

Exclusion Criteria

Patients with chronic suppurative otitis media—unsafe type, were excluded from the study. Patients with sensorineural and mixed hearing loss were also excluded from the study. Patients with congenital anomalies of the ear and systemic diseases such as diabetes mellitus and renal failure were not included. Patients who underwent revision surgeries were also excluded.

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The pure-tone audiograms of the patients whose incudostapedial joint was found to be eroded on table was analyzed, and the relevance of PTA as a predictor of incudostapedial joint necrosis was assessed.

Surgical Technique

The surgeries were done under local/general anaesthesia by post-aural/endarural approach by a single surgeon.

The incus was removed and sculpted to a suitable size and shape to fit between the stapes head and malleus handle and to come in contact with the tympanic membrane (Fig. 1). An acetabulum was created to accept the stapes capitulum and a notch in the short process to engage the neck of the malleus. Tympanic membrane grafting was done by the underlay technique using temporalis fascia graft. Single stage ossicular reconstruction was performed.

All patients were followed up at 1, 3 and 6 months. Audiometric analysis was done pre-operatively, at 3 months and at 6 months after surgery. Pre-operative PTA was calculated using frequencies of 500, 1,000, and 2,000 Hz. The air-bone gaps were calculated based on the comparison of pre-operative and postoperative average of the three speech frequencies. Comparisons were made between the pre-operative and post-operative audiograms with respect to pure-tone averages, air-bone gaps, and closure of air-bone gaps. The American Academy of Otolaryngology—Head and Neck Surgery guidelines define a post-operative ABG of 20 dB or less as a successful hearing result [4].

Results and Analysis

The study comprised of 13 females and 7 males. In the incus refashioning group the youngest patient was aged

Fig. 1 Picture showing the incus being refashioned

17 years and the oldest patient was aged 55 years. Majority of the patients fell into the 31–40 years group. The mean age was 36.65. Among the 20, 11 patients were operated in the right side and 9 patients were operated on the left side.

The mean pre-operative PTA was 49.18 dB HL. The minimum value being 45 dB HL and the maximum value being 64 dB HL (Table 1).

Discussion

In surgery for chronic otitis media, the reconstruction of the ossicular chain and successful physiological and functional results with long term stability are still a challenge even for experienced otologists [1, 5]. Usually the incus is removed and interposed after it has been sculpted to a suitable size and shape. The simplicity and practicality of using autograft in ossicular reconstruction has continued to hold attention of otologists over the years. Ease of preparation and excellent biocompatibility are major advantages apart from good sound conduction [6].

However, ossicular discontinuity is identified only if the discontinuity of the ossicular chain is confirmed at the time of operation. If pre-operative information can be used to determine whether or not the ossicular chain is intact, the patient can be better informed and the surgeon can be better prepared before surgery [7].

In our study the mean pre-operative PTA was found to be 49.18 dB HL. The values ranged from 45 to 64 dB HL. Complete disruption of the ossicular chain can result in a 60 dB hearing loss [8]. In CSOM, malleus is found to be the most resistant ossicle, the handle of malleus being the most commonly necrosed part of the malleus. Incus is found to be the most common ossicle to get necrosed in cases of CSOM. The commonest defect was erosion of the lenticular process, followed by the long process [9]. Kartush found erosion of long process of incus with an intact malleus handle and stapes superstructure as the most common defect [10]. However, Jeng [7] et al. found that, perforation of the tympanic membrane with an edge adherent to the promontory occurred significantly more frequently in patients with ossicular discontinuity ($P = 0.004$) than in those with intact ossicular chains. Surprisingly, an air-bone gap was not significantly correlated with ossicular discontinuity.

Conclusion

Incus necrosis is best predicted by the presence of moderate to moderately severe hearing loss (45–70 dB HL). Knowledge of this information preoperatively can influence surgical decision making and preparedness regarding ossiculoplasty and patient consent [11]. A good counseling

Table 1 Table showing clinical finding, pure tone average (PTA) and their corresponding Intra Op finding

Serial no	Clinical finding	Pure tone average (PTA)	Intra OP finding
1	Sub total perforation	51	Lenticular process erosion
2	Central perforation	53	Long process eroded
3	Central perforation	45	Lenticular process erosion
4	Central perforation	48	Long process eroded
5	Sub total perforation	48.3	Lenticular process erosion
6	Sub total perforation	50	Long process eroded
7	Central perforation	45	Lenticular process erosion
8	Central perforation	46.1	Lenticular process erosion
9	Sub total perforation	50.3	Long process eroded
10	Central perforation	46	Lenticular process erosion
11	Central perforation	58	Long process eroded
12	Central perforation	45	Lenticular process erosion
13	Sub total perforation	64	Long process eroded
14	Sub total perforation	48.3	Lenticular process erosion
15	Central perforation	46.6	Lenticular process erosion
16	Central perforation	50	Long process eroded
17	Central perforation	45	Lenticular process erosion
18	Sub total perforation	50	Long process eroded
19	Sub total perforation	46	Lenticular process erosion
20	Sub total perforation	48	Lenticular process erosion

of the patient to explain the outcomes before embarking on the surgery of choice to improve hearing based on PTA findings can be reasonably accurate. Although the sample size is small, it gives us an insight into both the qualitative and quantitative assessment of the middle ear transformer mechanism.

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