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The outcome of type I tympanoplasty in patients with chronic otitis media

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ABSTRACT

Background. *Tympanoplasty type 1 is a reconstruction of tympanic membrane perforation with an examination of the middle ear to ensure normality.*

Aim. *Assess the effect of the age of the patient, site, and size of tympanic membrane perforation on hearing gain and graft uptake in patients with chronic otitis media.*

Patients and method. *Thirty patients with type 1 tympanoplasty aged between 10 years and 50 years. Patients had been submitted for audiological tests and examination pre-operatively and at 1, 3 and 6-month intervals postoperatively.*

Results. *Improvement was 57% in 10-25 years, 59% in 25-40 years, and 56% in 40-50 years. While graft uptake was 90% in the three groups. Hearing improvement in anterior perforation was (60%), ost. perforation (41.5%), inferior perforation (43%). While the take rate is 100% in the post, perforation, 80% in anterior perforation and 83.3% in inferior perforation, hearing gain was 40% in large perforation, 66% in medium size and 77% in small size. While the take rate in small perforation was 100%, in medium perforation 90% and large perforation 80%. About 70% of patients had closure of the air-bone gap to within 15 dB and 83 % to within 20 dB.*

Conclusion. *Age had no impact on hearing gain and graft uptake. Size of perforation affects hearing gain and graft uptake where they are better in small and medium size perforation than large perforation. The site of perforation affects hearing gain and graft uptake where hearing gain was better in anterior perforation, while graft up was better in posterior perforation.*

Keywords: tympanoplasty, tympanic membrane perforation, chronic otitis media, hearing improvement, otorrhea

INTRODUCTION

The diagnosis of chronic otitis media (COM) implies a permanent abnormality of the pars tensa or flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion [1]. The classic term chronic 'suppurative' otitis media is no longer advocated as COM is not necessarily a result of 'the gathering of pus' [2]. The classification of tympanoplasty types that seem most widely used today is the modification of the classic Wullstein scheme by Nadol and Schuknecht [3]. The classes are type 1 (it simply involves reconstruction of tympanic membrane with middle ear exploration to ensure normality (ossicular chain intact and mobile)); type 2 (it restores the function of lever mechanism by placing an interposition graft between the long process of incus and stapes head); type 3 (the malleus and incus are absent it is divided into three subtypes (stapes columella; minor columella and major columella); type 4 (involve a canal

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wall down and a graft covering only the round window niche and the Eustachian tube opening); and type 5 (second stage procedure after eradication of the active disease. There are two subtypes Type Va) tympanoplasty and type Vb) [4,5]. Type 1 tympanoplasty (myringoplasty) have various techniques employed and these techniques are onlay graft, underlay technique, tympanomeatal graft and "pop" underlay technique [6]. The indications of tympanoplasty are conductive hearing loss due to tympanic membrane perforation or ossicular dysfunction, chronic or recurrent otitis media and recurrent otitis media due to contamination through a perforated tympanic membrane [7]. Perforation or hearing loss is persistent >3 months due to trauma, infection or sugar intake and inability to bath or participate in water sports safely due to perforation of the tympanic membrane [8].

Tympanoplasty is meaningless in dead ear or ears without useful residual cochlear function unless the suppurative component of the disease interfere with a patient's quality of life [7]. Other contraindications are dependent on varying conditions and the decision-making process should be highly individualized. There is no contraindication to sugar intake in older patients as long as their general health is good [9]. Children pose a special problem for otologic surgeons. Several arguments exist for and against tympanoplasty in children. The age-related dysfunction of the Eustachian tube increased incidence of URTI and the small diameter of a child's ear canal are strong arguments for postponing tympanoplasty in children. Tympanoplasty is not recommended under the age of 7 years [10].

METHOD

Study design and setting

This study was conducted at Al-Shaheed Ghazy Al-Hariri Hospital. We enrolled 55 patients between 2020 and 2021. During the intraoperative period, 5 patients were found to have ossicular damage, and they were excluded, and 20 patients did not follow-up postoperatively, as a result, they were excluded. Only 30 patients who had tympanoplasty operation, were followed-up for at least 6 months postoperatively.

Preoperative clinical and radiological examination

Preoperatively the analysis of symptoms and signs which are otorrhea, hearing loss, pain, vertigo, facial weakness and paralysis was done. Otologic examinations including auroscopic, microscopic, pneumatic otoscopic examination were done. A complete otolaryngological clinical examination was done. Audiological evaluation by pure tone audiometry was done pre- and postoperatively and tympanometry preoperatively was done. All patients had normal contralateral ear by both clinical examination and audiogram. CT scan is performed for all cases and it provides information about the size and degree of pneumatization of the mastoid from which the surgeon can assess how much room exists between the posterior meatal wall, middle cranial fossa above and lateral sinus behind with an assessment state of ossicles and facial canal.

Preoperative preparation

To maximize the rate of take for a graft, we tried to bring the infection under control for at least 30 days before the operation by frequent aural toilet and norfloxacillin drops, 25 were dry for 3 months preoperatively 5 had a history of otorrhea during the last 3 months.

Exclusion criteria

- Patient with perforation not healed after 6 months
- Only hearing ear
- Cases of cholesteatoma and ossicular erosion
- Ear trauma
- Facial nerve palsy

Classification of perforation

The size of tympanic membrane perforation has been classified as follows (small perforation (<25%); moderate perforation (25%-50%) and large perforation (>50%) [8]. The types of tympanic perforation are classified into anterior, posterior and inferior [8] (Table 1).

TABLE 1. *The distribution of the site and size of tympanic membrane perforation*

Types of perforation	No.	Small size	Medium size	Large size
Anterior	10	3	3	4
Posterior	14	7	7	-
Inferior	6	-	-	6

Technique

Postaural approach was used and underlay grafting technique was applied. The grafting material used was temporalis fascia or conchal cartilage.

Post auricular approach

Washing and shaving of the hair of the skin around the ear may be necessary. Skin preparation should be done with an aqueous solution such as povidone-iodine.

Procedure

Gentle forward traction is applied to the pinna by the assistant. A curved incision is made 5mm behind

the post-auricular fold starting at 12 o'clock posterosuperiorly (at the root of the zygoma) and terminating at the 6 o'clock position below. The subcutaneous tissue and muscles of the auricle are divided with a knife or diathermy needle using a cutting current. Two types of graft were used: Tempralis fascia and choncal cartilage

Temporalis fascia graft

The loose areolar layer above the temporalis muscle is identified with a scalpel, and the soft tissues are cut up to the posterior border of the external ear canal, without the canal being entered. A blunt double hook is used to elevate the skin, allowing the dissection to be continued superiorly, keeping in the plane superficial to the temporalis muscle. A 2 × 2 cm area of fascia is incised. The overlying periosteum is divided by a T-shaped incision, the vertical limb is current and runs parallel to the posterior meatal opening while the horizontal limb follows the supra meatal crest. The flaps of the periosteum are widely separated to expose the entire mastoid cortex, suprameatal triangle, spine and the bony posterior meatal margin from behind forward. A self-retaining two-pronged retractor is positioned to hold the outer part of the ear canal and the pinna forward. A second self-retaining retractor is positioned at right angles to hold the superior and inferior soft tissue away from the ear canal. Adequate exposure is essential. If the bony canal wall obstructs part of the tympanic membrane perforation and visualization can't be obtained by rotating the patient's head, then this prominence needs to be removed with a drill or curette until full visualization is achieved. The posterior meatal skin is dissected away from the bony wall, the annulus of the tympanic membrane is identified and elevated out of its bony groove, the annulus is gently pushed forward and the chorda tympani is identified and preserved. The graft is trimmed to the correct size with a pair of fine scissors. The graft should be larger than the perforation by 3 mm on all sides the graft was then inserted mediale to the tympanic membrane remnant and the handle of the malleus. The middle ear is usually packed with gelfoam for support.

Cartilage graft

The cartilage with perichondrium is harvested from the conchal area. An initial skin incision is made on the medial side of the concha. The cartilage with attached perichondrium was dissected medially and laterally from the overlying skin and soft tissue by spreading a pair of sharp scissors in a plane that is easily developed superficial to the perichondrium on both sides. Then a cut in the cartilage was made. The cartilage was then grasped and retracted inferiorly, the superior portion was then dissected while retracting which produced a large piece of cartilage. Small pieces of gel foam were placed under the perforation edge to support the graft. The posterior flap was elevated and the graft was placed under the tympanic membrane. The cartilage is placed on the promontory after thinning, with the perichondrium immediately adjacent to the tympanic membrane remnant, both of which are medial to the malleus. Gelfoam sometimes was placed lateral to the reconstructed tympanic membrane a wick soaked with povidone iodine or BIPP pack is used. The wound was sutured in layers.

Postoperative care

Broad-spectrum antibiotics were given for 10 days, stitches were removed on the seventh postoperative day. Changing of the pack was done after examination under a microscope or with an otoscope. Pure tone audiograms were done in the first, third and sixth postoperative months.

Statistical analysis

The data were analyzed using SPSS 22.0 statistics software. Categorical data are reported as numbers and percentages and quantitative data are reported as mean.

RESULT

The ages ranged between 10 and 50 years and were grouped as listed in Figure 1. About 20 patients were males 66.6% and 10 patients were females 33.3% (Figure 2).

Concerning the site of the perforation, 10 patients had anterior perforation (33.4%), 14 patients had posterior perforation (46.6%) and 6 patients had inferior

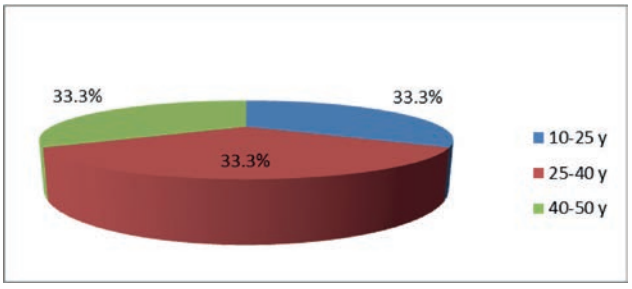

FIGURE 1. *The distribution of patients' age*

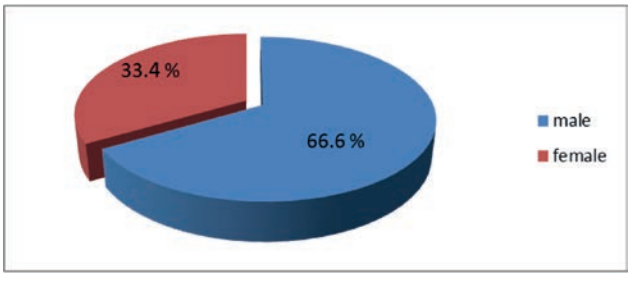

FIGURE 2. *The distribution of patients sex*

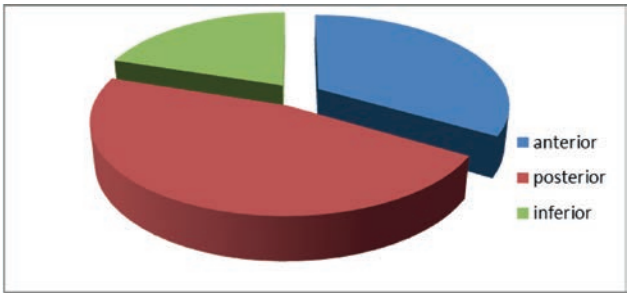

FIGURE 3. *The distribution of the site of perforation*

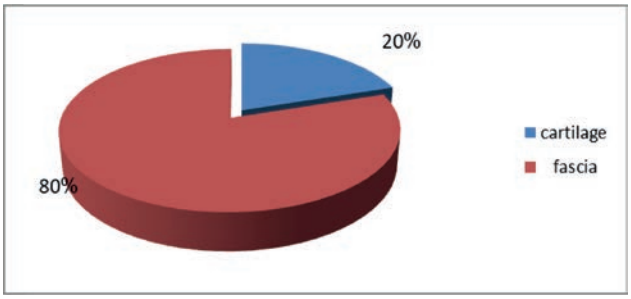

FIGURE 4. *The types of graft material used*

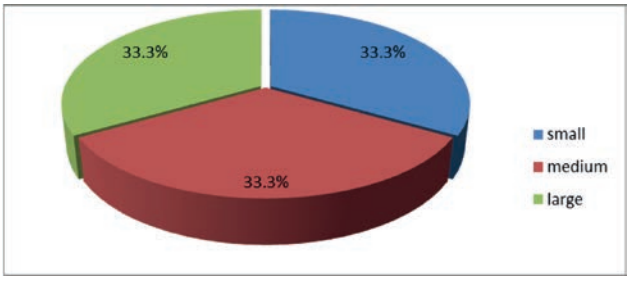

FIGURE 5. *The distribution of the size of perforation*

perforation (20%) (Figure 3). There were two types of graft material used for the cartilage: pericondrium graft (it was used in 6 patients – 20%) and temporalis fascia graft (it was used in 24 patients – 80%) (Figure 4). Ten patients (33.3%) had a perforation of about 25% of the total size of the tympanic membrane, ten patients (33.3%) had a perforation of about 50% of the total size of the tympanic membrane and 10 patients (33.3%) had a perforation of about 75% of the total size of the tympanic membrane (Figure 5).

The measurement of pre and postoperative bone conduction threshold in relation to the site of perforation is shown in Table 2. The pre- and postoperative air conduction threshold in different types of perforation is listed in Table 3. The average preoperative air conduction threshold for the anterior is lower than that for the posterior and inferior perforation. The improvement in air conduction threshold in anterior perforation was 13dB (50%). While the improvement in air conduction threshold in posterior perforation was 12.5dB (40.7%). In the inferior perforation, the improvement in air conduction threshold was 15 dB (44%). The improvement in air conduction threshold was more in the anterior

TABLE 2. *The pre and postoperative bone conduction threshold among the different types of perforation*

Bone conduction threshold (dB)	Anterior perforation	Posterior perforation	Inferior perforation
Average preoperative	10	14.3	13.3
Average postoperative	10	14.2	13.3

TABLE 3. *The pre- and postoperative air conduction threshold in different types of perforation*

Air conduction threshold (dB)	Anterior perforation	Posterior perforation	Inferior perforation
Average preoperative	26	30.7	33.3
Average postoperative	13	18.2	18.3

perforation than in the posterior and inferior perforations (Table 3).

The average reduction of air-bone gap in the group of patients with anterior perforation was 17dB (70% improvement), while in a group with posterior perforation was 10.9dB (51%) and in inferior perforation 15dB (50%). About 70% of patients had closure of air-bone gap within 15dB and 83% within 20 dB. The gain was higher in patients with small and medium size perforations. The percent of improvement is comparable between the three age group (Table 4-6).

TABLE 4. *The pre and postoperative air bone gap*

Air bone gap (dB)	Anterior perforation	Posterior perforation	Inferior perforation
Average preoperative	24.5	21.4	30
Average postoperative	7.5	10.5	15

TABLE 5. *The amount of reduction of air bone gap concerning the size of perforation*

Size of the perforation	Preoperative air bone gap	Postoperative air bone gap	% of improvement
25%	24	5.5	77%
50%	28	9	66%
75%	30	18	40%

TABLE 6. *The amount of gain in relation to the age of patients*

Age group	Preoperative air bone gap	Postoperative air bone gap	% of improvement
10-25 years	28	12	57 %
25-40 years	22	9	59 %
40-50 years	25	11	56%

Success was considered to be achieved when the graft was intact and in proper position at the most recent clinic visit. By these criteria 27(90%) of 30 cases was successful. Graft failure was noted from 1 to 6 months postoperatively. The relation between success rate and age groups was figured in Table 7, and size of

the perforation was figured in Table 8, and the site of the perforation was figured in Table 9.

TABLE 7. *Success and failure according age groups*

Age group	No.	Failed	Success	Take rate %
10-25 years	10	1	9	90%
25-40 years	10	1	9	90%
40-50 year	10	1	9	90%

TABLE 8. *Success and failure according size of perforation*

Size	Total	Success	Failed	Take rate %
25%	10	10	0	100%
50%	10	9	1	90%
75%	10	8	2	80%

TABLE 9. *Success and failure according site of perforation*

Site	Total	Failed	Success	Take rate %
Anterior	10	2	8	80%
Posterior	14	-	14	100%
Inferior	6	1	5	83.3%

DISCUSSION

In our study, the improvement was 57% in 10-25 year, 59% in 25-40 year and 56% in 40-50 year which are comparable with Singh et al [11] that stated that age not influence the hearing improvement in type I tympanoplasty, Dornhoffer [12] that reported sex and age had no impact on postoperative hearing results, and Khan and Parab [13] that reported cases of 99% in 20-40 years and 97% in 40-60 years.

In this study we found that the hearing gain in anterior perforation was more than posterior perforation. A dislike with Ribeiro et al [14] that the success rate was reported to be 88% in anterior perforation, 33% in inferior perforation and 100% in posterior perforation. Karela et al [15] stated that the site of perforation was noted as playing no particular role in hearing improvement.

In present study the improvement was 40% in large perforation, 66% in medium size and 77% in small size. Similarly, Ribeiro et al [14] reported small perforation give 80% improvement, while large perforation gives 68% improvement. Hammad and Gomaa [16] and Lee et al [17] said that the closure of small perforation result in greater hearing gain than large one. Karela et al said that the size of perforation was noted as playing no particular role in hearing improvement [15]. However, Denoyelle et al [18] mentioned the size of preoperative perforation did not correlate with functional success.

The average preoperative air conduction threshold (ACT) for anterior was lowers that for posterior and inferior perforation. The average gain in ACT for anterior was better than posterior and inferior. The mean preoperative 25dB while postoperative 16dB. Black et al [19] showed that significant improvement in ACT (mean preoperative 32dB while postoperative 12.8dB). Tuz et al [20] showed the ACT preoperatively was 38.6dB while postperatively was 27.9dB.

The average preoperative bone conduction threshold (BCT) was more in post than anterior and inferior perforation. However, postoperatively there's no significant improvement. Black et al [19] and Tuz et al [20] showed no significant difference between preoperative and postoperative. Whereas Vartiainen and Seppa [21] found 5% improved BCT in 181 cases and noted that it was not clinically significant.

In our study average preoperative air bone gap (ABG) 25.3dB and average postoperative ABG 11dB

Dornhoffer [12] showed the average preoperative ABG 21.1dB and postoperative ABG 6.8dB. Elasfour and Zaghloul [22] showed that average preoperative ABG 26dB while postoperative ABG 13dB. Khan and Parab [13] showed that mean preoperative ABG was 30dB and postoperative ABC was 7.13dB.

Findings revealed that the age has no effect on success rate (take rate was 90% in the three groups), however, Singh et al [23] mentioned that graft taking rate in patient below 14 year old was 80% and above 14 year old was 85%. Khan and Parab [13] documented that anatomical success rate was 97% in 11-20 year, 99% in 21-40 year and 97% in 40-60 year.

The success rate was 100% in small perforation, 90% in medium perforation and 80% in large perforation. As a result the anatomical success rate was better with small and medium size perforation. Singh et al [23] showed that success rate in graft taking was 100% in small perforation, 86% in medium size and 75% in large size. Ribeiro et al [14] documented that graft taking 88% in perforation <50% and 84% in perforation >50%. Karela et al [15] mentioned that the size of perforation was noted as playing no particular role in graft uptake.

The take rate is 100% in posterior perforation, 80% in anterior perforation and 83.3% in inferior perforation. The take rate was better in posterior perforation. These are supported by Ribeiro et al [14] study that showed take rate was 100% in posterior perforation and 84% in anterior perforation and 50% in inferior perforation. Singh et al [23] showed that take rate was 50% in anterior perforation, 88% in posterior perforation and 89% in inferior perforation. Karela et al [15] mentioned that the site of perforation has no role in graft uptake. While Singh et al [23] said that the site of the perforation was noted as having a significant effect on the outcome because anterior perforations had less

success rate than that of the posterior portions. Bhat and De [24] showed that anterior perforations had less success rate than that of the posterior ones.

CONCLUSION

The site of perforation affects the degree of hearing loss being more in the posterior perforation. The average ACT improvement after tympanoplasty is better with anterior perforation. Closure of perforation will improve air conduction. There's no improvement in bone conduction. The graft uptake is better in posterior perforation. The size of perforation affects the degree of hearing improvement being better with small and medium size perforation. While the take rate was better in small and medium size perforation. The age had no impact on outcome regarding hearing improvement and graft uptake.

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