TYPE I TYMPANOPLASTY IN ADULTS: FUNCTIONAL OUTCOMES AND PROGNOSTIC FACTORS

TYMPANOPLASTIE DE TYPE I CHEZ L'ADULTE: RESULTATS FONCTIONNELS ET FACTEURS PRONOSTIQUES

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ABSTRACT

Introduction: Type I tympanoplasty is a surgical procedure with a high anatomical success rate for the treatment of chronic otitis media. This study aims to identify the factors that may influence the hearing success rate of type I tympanoplasty.
Methods: A retrospective study was conducted on 105 patients who underwent type I tympanoplasty between January 2004 and December 2022 were retrospectively chart- reviewed. A through examination of the patients´ ossicular chain during the surgical procedure revealed it to be intact and fully functional. Patients with any other macroscopic otologic pathology, such as cholesteatoma, granulation in the middle ear, and osteitis in mastoid cells, were excluded from the study. The success criteria were defined as an improvement in hearing of at least 10 dB and an air-bone gap (ABG) of less than 20 dB, as determined through a follow-up period of six months.
Results: The study included 27 males and 78 females, with a mean age of 34,2 ± 12,8 years. At the six-month follow-up, 63,2% of cases demonstrated successful hearing outcomes. It has been observed that the closure of ABG and hearing improvement can be improved if the perforation surface is less than 50%, if it is posterior or subtotal, if cartilage is used as the graft material, and if the ear is kept dry during the operation. A statistical correlation was identified for preoperative ABG under 30 dB and for successful grafts six months after surgery (p=0,001 for both factors).
Conclusion: Despite the high success rate and routine nature of the procedure, the impact of many influencing factors on the hearing outcome remains a topic of debate.
Keywords: Tympanoplasty, Outcome, Prognosis, Adult.

RÉSUMÉ

Introduction: La tympanoplastie de type I est une procédure chirurgicale qui a un taux de réussite anatomique élevé pour le traitement de l'otite moyenne chronique à tympan ouvert. Cette étude vise à identifier les facteurs qui peuvent influencer le taux de réussite fonctionnelle de la tympanoplastie de type I.
Matériel et méthodes: Une étude rétrospective a été menée sur 105 patients ayant subi une tympanoplastie de type I entre janvier 2004 et décembre 2022. En per-opératoire, la chaîne ossiculaire des patients était intacte et mobile. Les critères de succès ont été définis comme une amélioration de l'audition d'au moins 10 dB et un Rinne inférieur à 20 dB après une période de suivi de 6 mois.
Résultats : Après 6 mois, une amélioration de l'audition a été obtenue dans 63,2% des cas. Il a été observé que la fermeture du Rinne et l'amélioration de l'audition peuvent être améliorées si la surface de la perforation est inférieure à 50 %, si elle est postérieure ou subtotale, si du cartilage est utilisé comme matériau de greffe et si l'oreille est sèche pendant l'opération. Une corrélation statistique n'a été trouvée que pour un Rinne préopératoire inférieur à 30 dB et pour des greffes réussies 6 mois après l'opération (p=0,001 pour les deux facteurs).
Conclusion: Malgré le taux de réussite élevé et la nature routinière de la procédure, l'impact de nombreux facteurs d'influence sur le résultat auditif est encore un sujet de débat.
Mots clés: Tympanoplastie, Résultats, Pronostic, Adulte

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INTRODUCTION:

Chronic otitis media results in damage to the middle ear, which in turn lead to the development of conductive hearing loss. Tympanoplasty is a surgical procedure that aim to repair the tympanic membrane, thereby conferring significant benefits to patients with tympanic membrane perforations. Such benefits include the prevention of ear infections, improvements in hearing, and ease of hearing aid usage [1].

Despite the high success rate and routine nature of the procedure, the impact of various influencing factors on hearing outcomes remains a topic of contention. These factors include the patient´s age, the site and size of the perforation, the condition of the ear during the operation, and the graft material. Furthermore, the preoperative ABG (Air Bone Gap) has been the subject of extensive study in multiple series [2,3].

The aim was to evaluate the factors that influence the hearing outcome following type I tympanoplasty.

METHODS:

The study cohort comprised 105 patients aged 18 years or above, who underwent type I tympanoplasty between January 2004 and December 2022. All patients were observed for a minimum of six months following the surgical procedure. Exclusion criteria included patients with involvement of the ossicular chain or mastoid cavity and patients who were followed for less than 6 months.

Prior to the surgical procedure, all patients underwent audiometry in order to calculate the preoperative ABG. All patients received general anesthesia with orotracheal intubation.

The postauricular approach method was used in all cases. The graft used was harvested either from the tragus or the cymba of the same ear and consisted of either fascia or cartilage. The prepared graft was then positioned laterally to the malleus handle. The external auditory canal was packed with Surgicel, and the incision was closed in layers. A review of the medical record of patients was conducted to obtain data on surgical findings and audiometry results.

A follow-up evaluation was conducted six months after surgery, to assess the anatomical and functional results. The hearing outcome was in this study using ABG measurements taken before and after the operation, as well as the hearing improvement value. The success of postoperative in hearing was defined as a postoperative pure-tone audiogram ABG of 20 dB or less, with a minimum hearing improvement of 10 dB.

The normality of quantitative variables was tested using the Kolmogorov Smirnov test. Quantitative variables were expressed as mean and standard deviation if the variable follows a normal distribution, otherwise as median and extreme values.

A univariate analysis was performed on the data collected, to study the association between epidemiological, clinical and therapeutic parameters and the anatomical and functional success of type 1 tympanoplasty.

Means were compared using Student's t-test for normal distribution and Mann Whitney U-test for non-normal distribution. Comparison of two means on two paired samples with non-Gaussian distributions was performed by the non-parametric Wilcoxon test.

A Chi-square test was used statistically compare different influencing factors.

RESULTS:

The study cohort comprised 105 patients consisting of 27 males (25,7%) and 78 females (74,3%), with a mean age of 34,2 ± 12,8 years (range 18–66 years).

There were 2 patients had undergone a previous tympanoplasty (1,9%). Fourty nine of cases had an anterior location (n= 49; 46,7%) and a large size (n=49; 46,7%). Prior to surgery, 63,8% of patients had an ABG exceeding 20 dB, while postoperatively, 36,2% demonstrated an ABG over 20 dB (Table1).

The presence of inflammatory mucosa of the middle ear was observed in 33 cases (31,4%), while myringosclerosis was identified in 19 cases (18,1%). The temporalis fascia was the most frequently used graft material (n=61; 58,1 %), followed by cartilage (n= 44; 41,9%). All patients underwent tympanoplasty using the underlay technique.

The success rate of the graft was found in 89 cases (85,7 %). This was achieved in 67 cases (63,2%) of cases with an average hearing gain of 15 dB (ranging from 0 to 40 dB). The mean ABG was 15 dB, with a range of 0 to 70 dB.

Table 1: Pre-operative and postoperative ABG value

ABG (dB)	Preoperative n (%)	Postoperative n (%)
0-10 dB	2 (1,9%)	43 (40,9%)
11-20 dB	36 (34,2%)	29 (27,6%)
21-30 dB	47 (44,7%)	16 (15,2%)
>30 dB	20 (19%)	17 (16,1%)
TOTAL	105 (100%)	105 (100%)

The analysis revealed that age and gender were not significant factors influencing the hearing result (p=0,68 and p=0,16 respectively). The study revealed that small perforations had superior success rate (66,07% and p=0,30). The best audiological outcome was associated with subtotal and posterior perforations. In contrast, the data indicated that anterior perforations were the most strongly correlated with failure (38,8% and p=0,87) (Table 2).

Table 2: Factors influencing the hearing outcomes after type I tympanoplasty

	Postoperative ABG >20dB and/or Gain<10dB	Postoperative ABG ≤20 dB and Gain ≥10dB	p
Age (Mean± SD)	34,9± 13,4	33,8± 12,5	0,68
Gender Male (n=27) Female (n= 78)	 22,2% 12,8%	 77,7% 87,1%	0,165
Size Small (n=56) Large (n=49)	33,9% 38,7%	66,07% 61,2%	0,308
Site Subtotal (n=30) Anterior (n=49) Posterior (n=26)	33,3% 38,8% 34,6%	66,7% 61,2% 65,4%	0,871
State of ear Dry ears (n=72) Discharged ears (n=33)	 33,3% 42,2%	 66,7% 57,6%	0,36
Graft type Fascia temporalis (n=61) Cartilage (n=44)	 39,3% 31,8%	 60,7% 68,2%	0,428
Myringosclerosis No (n=73) Yes (n=32)	 37% 34,4%	 63% 65,6%	0,798
Graft success Yes (n=89) No (n=16)	29,2% 75%	70,7% 25%	0,001
Pre-operative ABG Median value (dB) [Min-Max]	30 [10-50]	25 [10-50]	0,001

Cartilage grafts had a higher overall success rate (68,2%) compared to fascia temporalis (60,7%). Postoperative gain was higher for patients with cartilage graft but it was non-significant (p=0,261), but the statistical correlation was not significant (p=0,428). Comparison of preoperative ABG, postoperative ABG and hearing gain values between the cartilage and fascia groups found no statistically significant difference. This does not allow us to conclude that one graft material is superior to another in terms of functional outcome (Table 3).

Table 3: Comparison preoperative, postoperative ABG and gain between the group cartilage and the group fascia

	Cartilage graft	Fascia Graft	P
Preoperative ABG (dB)	27,5 [15-50]	25 [10-45]	0,051
Postoperative ABG (dB)	15 [0-70]	15 [0-60]	0,572
Gain (dB)	15 [0-40]	10 [0-30]	0,261

The presence of myringosclerosis was found to have no significant impact in the functional outcomes (p=0,79). Furthermore, patients with successful grafts had higher functional success rates (p=0,001).

Another factor that influenced the results was the preoperative ABG. A median ABG value of 25 dB was associated with a higher success rate (p=0,001). A high preoperative ABG was significantly correlated with hearing failure (p=0,03). Indeed, a good hearing outcome was observed for patients with a preoperative ABG of less than 30 dB in 70,6% of cases.

DISCUSSION:

Type 1 tympanoplasty is the most frequently performed surgery in otology. Its aim is to restore the integrity of the tympanic membrane, thereby improving the patient's quality of life. Closure of the tympanic fundus helps prevent recurrent otorrhea caused by warm-up episodes. The success of this surgery, both anatomically and functionally, depends on a number of factors. We studied 105 patients, which enabled us to study our variables on a large number of subjects and to draw conclusions that we could compare with those in the literature.

Our work is a retrospective, descriptive, longitudinal study spanning 18 years. The retrospective nature of the study meant that some data could not be collected; data that were deemed to have a minor impact on the results. The patients were operated on by multiple surgeons of different generations, with varied experience and approaches.

The findings of our study indicate that age is not significant to be a determining factor in determining hearing outcomes. However, Dispenza [3] reported superior hearing outcomes for patients under the age of 50. Lin et al. [4] concluded that patients over the age of 60 had lower success rate compared to younger patients.

The majority of studies have indicated that anterior perforations are associated with the poorest functional outcomes [3,5-8]. However, García [9] and Dawood [10] have concluded that subtotal perforations are the most strongly correlated with functional failure.

Similarly, the studies conducted by Lima [5], Dispenza [3] and Ozdamar [11] revealed no statistically significant correlation between the size of the perforation and the success of audiological outcome (p>0,05). Additionally, Emir [2] determined that perforation size had a significant impact on postoperative ABG. Singh et al. [12] reported that perforations of a large size were associated with a higher failure rate (p= 0,012).

The majority of studies have revealed no significant correlation between audiological failure and myringosclerosis [5, 13, 14].

Nevertheless, Onal [15] and Lima [5] have indicated that patients with dry ears tend to exhibit more favorable audiological outcomes. Furthermore, a poor hearing prognosis was associated with the presence of an inflammatory condition affecting the mucosa [6, 16]. The histological deterioration of the graft was attributed to a chronic and severe inflammatory process, which in turn led to a modification of the columellar effect in the ear.

Several studies have identified a significant correlation between the graft material and hearing outcomes. Ozdamar [11] and Khoza-Shangase [17] reported a significant decrease in postoperative ABG within each group (cartilage and fascia: p = 0.2 and p = 0 ,73). Jain [19] and Onal [15] observed higher hearing gain for cartilage grafts, although the difference was not found to be significant in either case. Salviz [19], Callioglu

[20], Bhardwaj [21] and Ozdamar [11] reported that aponeurotic grafts result in greater hearing gain than other types of grafts (Table 4).

Table 4: Comparison of hearing gain between group cartilage and group fascia in different studies.

Author	Group fascia temporalis (mean ±SD)	Group cartilage (mean ± SD)	P
Jain A [18]	17,2 ± 8	19 ± 10,9	>0,05
Bhardwaj [21]	14,98 ± 9,915	11,41 ± 8,28	>0,05
Ozdamar [11]	14,3 ±8,4	12,9 ±6,95	>0,05
Onal [15]	11,63 ± 12,62	14,49 ± 10,05	>0,05
Our study	12,5±10,2	15,4±12	0,19

Furthermore, it was determined that anatomical failure was a significant predictor of functional failure, with 75% of cases resulting in poor functional outcomes (p = 0.001). Anatomical success was also found to be significantly associated with greater hearing gain (p = 0.02). Yilmaz [22] and Pfammatter [23] have also demonstrated the importance of anatomical outcomes for functional success.

The present study revealed a statistically significant correlation between the increase in preoperative ABG and functional failure (p = 0.03). The success rate was 70.6% for a preoperative ABG value between 10 and 30 dB, and 35% for a value greater than 30 dB. Yilmaz [22] also reported that the hearing success rate increased significantly when the preoperative Rinne was low. Furthermore, a failure rate of 0% was observed for a preoperative ABG between 11 and 20 dB.

A good surgical technique with otoendoscopy, associated with convenient graft material in the hands of an experienced surgeon, will give better results. Dumbell perichondrial cartilage graft clip-on fits perfectly on the perforation, giving satisfying outcomes as reported in the literature. In fact, dumbell perichondrial cartilage has been the alternative in the successful repair of anterior perforations [24].

CONCLUSION:

The study examined the influence of various factors on the functional outcome of type I tympanoplasty. The analysis revealed that age and gender had no significant impact on the results. Patients with a small size and posterior site of the tympanic perforation had favourable hearing outcomes. The use of dry mucosa and cartilage graft during the surgical procedure was also associated with good hearing results. Furthermore, a good anatomical result was significantly correlated with functional success. Finally, a low preoperative ABG value was also significantly associated with good hearing outcomes.

CONFLICT OF INTEREST

There are no conflicts of interest.

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