

Research

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Tympanoplasty Outcomes in Dry and Wet Ears

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**ABSTRACT**

**Introduction:** Chronic suppurative otitis media is a major public health problem in children and adults. Tympanoplasty is a surgical procedure which aims to prevent recurrent otorrhea and restore hearing ability.

**Objective:** To compare the graft uptake and the hearing outcome of tympanoplasty in non cholesteatomatous chronic otitis media between wet and totally dry ears.

**Methods:** A total of 108 wet ears (with mucoid discharge) and 232 dry ears (at least 3 months before surgery) with chronic suppurative otitis media were operated on by myringoplasty between 2000 and 2014. Postoperative graft uptake and hearing gain rates were compared between both groups.

**Results:** Cartilage was used in 100% of wet ears and 35% of dry ears. In the other cases, temporalis fascia was the chosen graft. Anatomical success rate was 88% for the wet ear group and 87.5% for the dry ear group. The hearing gain rate was 62% for the wet ear group and 56% for the dry ear group. Differences were found to be statistically non significant for both graft uptake ( $p=0.9$ ) and hearing gain ( $p=0.29$ ). In the wet ear group, only age <40 years was found to be a predictive factor of audio logical success in tympanoplasty ( $p=0.001$ ).

**Conclusion:** The success of myringoplasty is not adversely affected by the presence of mucoid ear discharge at time of surgery, and outcomes are comparable to those of the operation done for dry ears.

**KEYWORDS:** Tympanoplasty; Chronic otitis media; Wet ear; Cartilage graft.

**INTRODUCTION**

Chronic suppurative otitis media is a major public health problem in children and adults. It is characterized by recurrent middle ear discharge through a tympanic membrane perforation.<sup>1</sup> Tympanoplasty is a surgical procedure which aims to prevent recurrent otorrhea and restore hearing ability.<sup>1</sup> The literature mentions several factors that may affect surgical results, including age, perforation size and site, the status of the opposite ear, the type of graft and condition of the operated ear (dry or wet). Controversy exists about the condition of the middle ear as a prognostic factor in myringoplasty.

**OBJECTIVE**

The purpose of this study was to compare the graft uptake and the hearing outcome of tympanoplasty in non cholesteatomatous chronic otitis media between wet and totally dry ears, focusing on factors that may have influenced the success of surgery in wet ears.

**METHODS**

We conducted a retrospective study between January 2000 and December 2014 about 306 patients (340 ears) with chronic suppurative otitis media (CSOM). All patients had a perforation in the pars tensa and underwent a primary tympanoplasty without mastoidectomy. Those with

attic perforation or cholesteatoma were excluded from the study.

Patients were divided into two groups:

- Group 1 (Dry perforation group): when there was no evidence of otorrhea within three months before surgery.

- Group 2 (Wet perforation group): when there was any degree of discharge before surgery, granulation tissue, inflammatory, thickened or polypoidal mucosa in the middle ear. Preoperative audiometry was systematically performed.

For each patient we analyzed: age, gender, history of adenoidectomy or tonsillectomy, condition of the affected and the contralateral ear, size, type and location of the perforation, surgical technique, graft material and its placement. Size of the perforation was considered large when it exceeded the quarter area of the tympanic membrane. It was classified anterior or posterior relative to the long process of the malleus.

All tympanoplasties were performed under general anesthesia. Regarding the bilateral cases, a six months interval was contemplated between both surgeries.

Anatomical success, evaluated by microscopy, was defined as an intact graft without lateralization, retraction, inflammation or infection at the last follow-up visit with a minimum of 6 months. Patients were observed for an average time period of 30 months after surgery varying between 6 months and 6 years.

Auditory function was analyzed by performing preoperative and postoperative tone threshold audiometry at 3 months, 6 months and one year after surgery. Functional failure was defined by an air bone gap (ABG) of 0.5, 1 and 2 kHz more than 10 dB.

Hearing restoration was considered successful if the post-operative air bone gap (ABG) was less than 10 dB, calculated on the frequencies of 500 Hz, 1000 Hz and 2000 Hz. Statistical analysis was performed using SPSS® 19. We

conducted Chi-square study of qualitative variables. Statistical significance was assigned to a  $p \leq 0.05$ .

**RESULTS**

In our study of 306 patients, there were 204 females and 102 males (sex-ratio=0.3). The mean age was 34.6 years [7-74 years]. Otitis media during childhood was the most frequently seen disorder, reported in 97% of cases. The mean symptoms were as follows: otorrhea (33%), hearing loss (30%) and tinnitus (11%). On examination, the perforation was wet in 32% of cases (Group 2) and totally dry in 68% of cases (Group 1) (Figure 1).

Past medical history revealed allergic rhinitis in 13% of wet ears *versus* 2% of cases in dry ears ( $p=0.0001$ ) (Table 1). Previous adenoidectomy during childhood was performed in 9% of patients from Group 1 *versus* 3% of patients from Group 2 with a statistically significant difference ( $p=0.05$ ).

Tympanic membrane perforation was anterior in 30%, subtotal in 28%, posterior in 19%, inferior in 15% and central in 6% of cases. In patients with wet ears, systemic and local antibiotics were delivered before surgery. Preoperative audiometry revealed a conductive hearing loss in 62%, a mixed hearing loss in 32% and was normal in the other cases. The mean ABG was 29.9 dB in group 1 and 32 dB in group 2 with no statistically significant difference ( $p=0.8$ ).

All procedures were done under general anesthesia with a post auricular approach in 97% and a transmeatal technique in 3% of cases. Incision of the external auditory canal was performed between the 6 and the 12 o'clock direction and the tympanoepital flap was detached. The ossicular chain was discontinued in 30% of cases in group 1 and 20% of cases in group 2 ( $p=0.05$ ). The uncus was the ossicle the most frequently lysed in both groups.

We performed a type I tympanoplasty in 80% and a type II tympanoplasty in 20% of all cases. Cartilage graft (conchal or tragal) was used in 100% of wet ears and 35% of dry ears ( $p=0.02$ ). In the other cases, temporalis fascia was the chosen

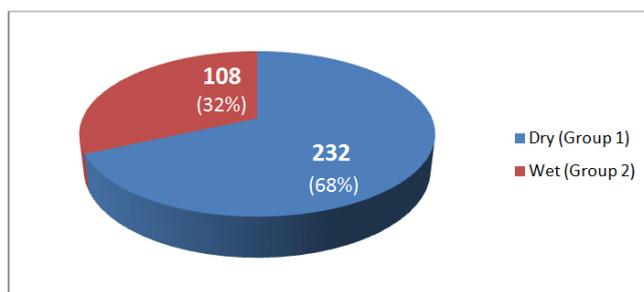


Figure 1: Patient's repartition according to the status of the middle ear.

	Group 1 (232 ears)	Group 2 (108 ears)	Total (340 ears)	p-value
<b>Allergic rhinitis</b>	6(2%)	14(13%)	20	0.0001
<b>Adenoidectomy</b>	21(9%)	4(3%)	25	0.05
<b>Otitis media in childhood</b>	211(90%)	99(91%)	310	0.9
<b>Perforation type:</b>				
- anterior	73	29	102	
- posterior	42	23	65	
-subtotal	70	27	97	
-inferior	39	15	54	
-central	8	14	22	
<b>Tympanoplasty</b>				
- Type I	185(80%)	87(80%)	272	
- Type II	47(20%)	21(20%)	68	
<b>Surgical approach</b>				
- post auricular	225	105	330	
- transmeatal	7	3	10	
<b>Ossicular chain:</b>				
- <b>complete</b>	164(70%)	87(80%)	251(73%)	
- <b>discontinued</b>	68(30%)	21(20%)	89(27%)	
* malleus	20	5	25	0.05
* uncus	32	13	45	
* malleus+uncus	16	3	19	
* stapes	-	-	-	
<b>Ossicular chain:</b>				
- mobile	142(61%)	91(84%)	233(68%)	0.003
- tympanosclerosis	90(39%)	17(16%)	107(32%)	
<b>Graft</b>				
-Cartilage	82(35%)	108(100%)	190(55%)	0.02
- Conchal	73(90%)	74(68%)	147(76%)	
- Tragal	9(10%)	34(32%)	43(24%)	
-Temporalis fascia	150(65%)	-	150(45%)	
<b>Conchal cartilage</b>	165(71%)	73(67%)	238(70%)	
<b>Tragal cartilage</b>	67(29%)	35(33%)	102(30%)	

Table 1: Comparative findings between the two groups.

graft. After it was shaped, it was placed using the underlay technique, under or over the malleus handle depending on the perforation features and the anatomical conditions. Gel foam was used to support the graft and the tympanomeatal flap was repositioned. Meatal pack was used in all cases and removed by the third post-operative day.

On the last post-operative assessment, we observed a total graft integration without retraction, perforation or shifting in 87.5% of group 1 versus 88% of group 2, without a statistically significant difference ( $p=0.9$ ) (Table 2). On the other hand, post-operative audiometry revealed ABG closure in 56% of group 1 versus 62% of group 2 ( $p=0.29$ ). The mean hearing gain was 16.2 dB in dry ear group and 16.9 dB in wet ear group ( $p=0.9$ ).

We also analyzed predictive factors of anatomical and functional success in wet ear group.

We concluded that age <40 years predicted better postoperative hearing gain with 74% of audiological success versus 39% for patients aged >40 years ( $p=0.001$ ). Moreover, placing the graft under the malleus handle predicted better audiological results with 80% of success ( $p=0.04$ ) (Table 3).

Other factors seemed to influence positively the

outcome of tympanoplasty, without a significant correlation. These factors were: female sex, the absence of allergic rhinitis, a central perforation, a normal ossicular chain, the use of conchal cartilage and the placement under the malleus handle.

**DISCUSSION**

Chronic suppurative otitis media is a major public health problem in children and adults. It is characterized by recurrent middle ear discharge through a tympanic membrane perforation.<sup>1</sup> The main symptoms in this disease are intermittent otorrhea and hypoacusis.<sup>2</sup>

Tympanoplasty aims to prevent recurrent otorrhea and restore hearing ability.<sup>1,3</sup>

Several factors influencing surgical results in myringoplasty are mentioned in literature such including age, perforation size, perforation site, status of the contralateral ear, status of the middle ear mucosa, type of graft.<sup>2,4</sup>

The tympanic membrane is considered wet when one of these conditions is present:<sup>5</sup>

- remnant tympanic membrane is congested;

	Group 1	Group 2	p-value
<b>Anatomical success</b>			
- yes	203(87.5%)	95(88%)	0.9
- no	29(12%)	13(12%)	
- retraction	5	-	
- perforation	12	6	
- shifting	12	7	
<b>Hearing improvement</b>			
- yes	130(56%)	67(62%)	0.29
- no	102(44%)	41(38%)	
<b>Mean hearing gain</b>	16.2 dB	16.9 dB	0.9
<b>Post-operative complications:</b>			
- myringitis	9	6	
- cholesteatoma	3	3	

Table 2: Anatomical & functional results of tympanoplasty in dry and wet ears.

	Anatomical success		Audiological success	
<b>Age</b>				
<40 years	88%	p=0.9	74%	p=0.001
>40 years	86%		39%	
<b>Sex</b>				
- male	87%	p=0.39	66%	p=0.9
- female	95%		65%	
<b>Allergic rhinitis</b>				
- yes	82%	p=0.4	52%	p=0.4
- no	89%		63%	
<b>Perforation site:</b>				
- marginal	90%	p=0.3	68%	p=0.39
- central	100%		70%	
<b>Ossicular chain</b>				
- normal	88%	p=0.7	65%	p=0.1
- discontinued	85%		47%	
<b>Cartilage</b>				
- conchal	89%	p=0.6	67%	p=0.1
- tragal	85%		51%	
<b>Graft placement</b>				
- under the malleus handle	100%	p=0.06	80%	p=0.04
- over the malleus handle	90%		51%	
- sandwich	87%		60%	

Table 3: Prognosis factors of tympanoplasty in wet ears.

- the middle ear mucosa is congested, polypoida or oedematous;
- perforation margins are oedematous or granular;
- discharge seen through the perforation;

For most authors, the wet or dry ear condition of the ear preoperatively was found to be of no predictive influence on anatomic or functional success.<sup>2,6-15</sup>

For Nagle,<sup>15</sup> closure rate was 88% for dry ears and 74% for wet ears without a significant difference ( $p=0.07$ ). A hearing gain rate more than 10 dB was seen in 72% for dry ears *versus* 60% for wet ears ( $p=0.85$ ). For Webb,<sup>7</sup> in a retrospective study of 205 ears, the rate of revision surgery was 26% in the wet group *versus* 40% in the dry perforation group without significant difference (Table 4).

In the study of Claes,<sup>6</sup> the influence of dry preoperative status of the ear was only present in patients with more than 30 dB preoperative ABG. For Shankar,<sup>16</sup> neither the type nor the presence of discharge in the middle ear influenced the success

rate of surgery.

A meta-analysis done by Vrabec et al.<sup>17</sup> considering the effect of otorrhea on closure rate indicates that tympanoplasty on a discharging ear is as successful as in a dry ear.

Contrary to our results, many studies have reported that a discharging middle ear at time of surgery influences negatively the outcome of myringoplasty.<sup>18-20</sup> Uyar<sup>20</sup> found that there was a significantly higher rate of graft uptake in patients with dry ears for three months preoperatively. He thus recommends perform tympanoplasty when the ears have been dry for at least three months. Gersdorff<sup>21</sup> and Pignataro<sup>22</sup> found a better outcome when operating on a dry ear, and both recommended medical treatment of discharging ears to control the inflammatory changes before myringoplasty. Onal et al.<sup>23</sup> reported that myringoplasty is more likely to be successful if the ear has been dry for at least one month.

Similarly, Pinar<sup>18</sup> found a significant association be-

	Surgical success		p-value	Audiological success		p-value
	Dry ears	Wet ears		Dry ears	Wet ears	
Nagle <sup>15</sup>	88%	74%	0.07	72%	60%	0.85
Webb <sup>7</sup>	10%	7%	0.06	-	-	-
Hosni <sup>4</sup>	90.4%	87%	0.6	92%	91%	1
Pinar <sup>18</sup>	79%	64%	0.003*			
Dhar <sup>11</sup>	96%	84%	0.09			
De Lima <sup>2</sup>	94%	100%	0.3			
Claes <sup>8</sup>	-	-		51%	48%	0.01*
Shankar <sup>16</sup>	88%	80%	0.5			
Naderpour <sup>12</sup>	97%	94%	0.89			
<b>Our study</b>	87.5%	88%	0.9	56%	62%	0.29

**Table 4:** Graft intake and audiological success of tympanoplasty in dry and wet ears according to authors.

tween dry ear and success of tympanoplasty. Indeed, graft intake rate was 79% for dry ears *versus* 64% for wet ears ( $p=0.003$ ). For this author, more than three months dry period of the ear and a middle ear risk index (MERI) less than 3 were found to be statistically significant prognostic factors that affect success rate. Takahashi<sup>24</sup> found that the presence of granulation tissue or oedematous mucosa in the middle ear impairs the function of transmucosal gas exchange and increases the distance between the middle ear cavity and the capillaries. This may result in surgical failure of tympanoplasty in wet ears.

On the other hand, few studies revealed a positive effect of ear discharge on graft uptake.

Caylan et al<sup>25</sup> have reported better healing of the tympanic membrane after myringoplasty in a discharging ear with 100% of success rate, while it was 75% in dry ears. They attributed such better results to the probable increase in the vascularity of the middle ear, which could have favored better healing in wet ears.

Vijeyandra<sup>5</sup> did a histopathological study of the remnant tympanic membrane of 20 dry and 20 wet central perforations. They concluded that in wet central perforation, all the layers of epithelium were present and there were a raised number of inflammatory cells and blood vessels. Also, the fibrous layer was present, contrarily to dry ears. According to this author, draining central perforation was not a contraindication for tympanoplasty as these anatomical conditions promote the graft intake.

Although better hearing gain and graft intake were observed for wet ears in our study, the difference was not statistically significant. We can then conclude that the wet or dry condition has no influence on anatomic or functional results.

Also, in the present study, only age <40 years and the placement of the graft under the malleus handle predicted better postoperative hearing gain with 74% and 80% of audiological success respectively. Female sex, the absence of allergic rhinitis, the normality of the ossicular chain and the use of conchal cartilage were associated with better anatomical and functional

results, but the influence of the latter factors seemed to be rather weak.

Temporals fascia and perichondrium alone often fails as graft material for tympanic membrane reconstructions because of their low stability and tendency to atrophy over the years.<sup>26</sup> However, cartilage graft is characterized by its resistance to resorption, retraction and negative pressure in middle ear.<sup>26,27</sup> Its connection to the surrounding tissue and its suitable elasticity for sound transmission make it a material of choice in tympanoplasty especially for wet ears.<sup>29</sup> For optimal acoustic transfer behavior, since the cartilage is formed mainly by type 2 collagen, it should be cut as thin as possible.<sup>26</sup>

In our study, we used cartilage (conchal or tragal) in 100% of wet ears and 35% of dry ears. In wet ear group, better anatomical and audiological outcomes were observed with conchal cartilage compared to tragal cartilage graft.

A limitation of the present study would be the fact that tympanoplasties were not performed by the same surgeon in our establishment. The type of graft as well as the graft placement technique was not the same for all operated ears. This may affect surgical results.

**CONCLUSION**

Based on our data, mucoid ear discharge does not interfere with the results of tympanoplasty and has no adverse effect on the surgical outcome and the postoperative hearing gain. Indeed, achieving surgical success depends more on meticulous graft placement rather than the status of the operated ear.

**CONFOUNDING VARIABLES IN THE PRESENT STUDY**

The results of this study may be influenced by some confounding variables:

- **Type of graft:** For all wet ears, we used systematically cartilage graft. This graft is well known for its stability and better resistance to retraction and re perforation. This may have

affected the anatomical results.

- **Age:** For all children, tympanoplasty was performed using cartilage graft. This is due to Eustachian tube dysfunction seen in pediatric population.

- **Surgeon:** tympanoplasties were not performed by the same surgeon. This may have affected the surgery outcomes.

**CONFLICTS OF INTEREST:** None.

**CONSENT STATEMENT**

As our article did not publish any personal photo or information regarding any of the patient in my manuscript thus the consent is not required for the article publication.

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