

ORIGINAL ARTICLE

TYPE-I TYMPANOPLASTY BY UNDERLAY TECHNIQUE – FACTORS AFFECTING OUTCOME

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Background: Type-I Tympanoplasty is an operation which is widely done to close a persistent tympanic membrane perforation after clearing the disease from the middle ear. It is very safe and effective procedure. The success rate varies in different setups and there are some confounding factors which affect the result of Type-I tympanoplasty like the size, type and location of perforation. By conducting this study, we aimed to calculate the success rate of Type-I Tympanoplasty in Ayub Teaching Hospital and assess which confounding factors affect the success rate. **Methods:** This case series study was conducted at Ayub teaching hospital from 1st January 2014 to 31st December 2015. All the patients who presented with dry ears, no nasal disease and persistent tympanic membrane perforations during this period were operated upon and overall success rate was calculated. In addition, the relationship between the site of perforation, size of perforation and the type of perforation and the success rate of Type-I Tympanoplasty was also calculated. **Results:** One hundred and thirteen patients were included in this study. Out of these 91 (80.5%) showed complete healing after surgery. Anterior perforations were found to fail the procedure in 41.7% of the cases, while central perforation failed in only 5.4% of the cases. In cases of marginal perforations healing was significantly decreased, i.e., only 47.1% while it was 94.9% in cases where annulus was not involved. Larger perforations also showed poor surgical outcome. 100% of the small perforation healed completely while only 58.3% of the large perforations showed successful result after surgery. When *p*-value was calculated all of these findings were more than 95% significant. **Conclusion:** There is a significant association between the healing of tympanic membrane after Type-I Tympanoplasty and site, size and type of perforation. Anterior perforations, marginal perforation and large perforations reduce the chances of successful outcome of Type-I Tympanoplasty.

Keywords: Type-I Tympanoplasty; Size of perforation; Site of perforation; Outcome percentages

J Ayub Med Coll Abbottabad 2017;29(2):258–61

INTRODUCTION

Middle ear diseases are very common in our country. 95% of the children develop AOM (Acute Otitis media) in their first 5 years of life and majority are left untreated. 80% of these perforations heal without any intervention¹ but a significant number of children develop CSOM (Chronic Suppurative Otitis Media) and have persistent perforation in their tympanic membranes. Some children have nasal allergies or enlarged adenoids. These patients can develop secretory otitis media which if left untreated can cause retraction of the tympanic membrane. These patients are treated by grommet insertion in the ear. This grommet can also cause residual perforation when it is removed or is extruded spontaneously. Tubes that require removal have a higher incidence of residual perforations.² Trauma to the ear by slaps on the ear or by blast injuries is also an important cause of tympanic membrane perforation.^{3,4}

Tympanic membrane is an important part of the sound conduction system. In addition to hearing, an important function of the TM is protection of the

middle ear. Middle ear when exposed to water gets infected and as a result there are chances of recurrent attacks of AOM. This recurrent AOM can progress to CSOM with possible extracranial as well as intracranial complications.² Closure of the tympanic membrane can prevent the patient from these potential risks.⁵

Type-I Tympanoplasty is a procedure which is done to close the tympanic membrane perforation after inspecting the middle ear and clearing any residual disease. It is a very safe procedure⁶ with very few complications. Two techniques are mostly used for the repair of the tympanic membrane. The underlay and the onlay technique.¹ Underlay technique is the most widely used technique with good postoperative results.¹ Another technique used to repair only the tympanic membrane is fat graft myringoplasty.⁷

We are routinely doing the Type-I Tympanoplasty in our hospital. By this study, we are assessing the outcome of this procedure in our setup and we will try to find out the confounding factors resulting in failures. We will also compare it with the outcomes in other setups.

MATERIAL AND METHODS

This case series study was conducted at Ayub Teaching Hospital Abbottabad from 1st January 2014 to 31st December 2015. All the patients who were operated during this time period were included in the study. Informed consent was taken from all the patients who were included in the study.

Patients who were operated were followed up for a period of minimum 6 months and their grafts were assessed for healing. The patients were examined after one month then after 2 months and then after 6 months each. Unhealed tympanic membrane meant that there is residual perforation in the tympanic membrane as seen on the final postoperative visit.

We also documented the site and size of perforations and checked for any relationship with graft rejection. Marginal and central perforations were also checked for their success rates.

All the patients had preoperative evaluation for any nasal disease and were treated for it before undergoing Type-I Tympanoplasty. The ears were examined periodically in the preoperative period and a minimum period of 4 months of dry ears elapsed before going for surgery.

Children below 16 were excluded from the study. Also, patients who had any nasal disease and did not receive any treatment for it were also excluded from the study.

Data analysis was done using SPSS-21. The percentages were calculated for the categorical variables and the effect of different factors on the outcome was assessed and *p*-value was calculated and the value of 0.05 was taken as significant.

RESULTS

A total of 113 patients were included in this case series. Out of these 61 (54%) were males and 52 (46%) were females.

Age range was from 16 to 51 years. Our youngest patient was a 16-year-old boy and oldest patient was also a male 51 years of age. Age grouping was done in three. The first group was from 16 to 25 years. The second was from 26 to 40 years and the third group was above 41 years. Only 6 (5.3%) patients were above 41 years of age. Fifty-four (47.8%) patients were between 16–25 years. And 53 (46.9%) patients were between 26–40 years of age.

Right ear was operated in 63 (55.8%) patients and left ear was operated in 50 (44.2%) patients. Patients were followed up for a minimum period of 6 months and at that time 91 (80.5%) patients had completely healed tympanic membranes. About 22 (19.5%) patients showed non-healing of

their tympanic membranes when they were examined after 6 months of surgery.

The site of perforation was divided as Anterior, Central and Posterior perforations. Anterior perforations are those which are involving the anterior part of the pars tensa with or without involving the annulus. Similarly, posterior perforation is mainly involving the posterior part of the pars tensa with or without involving the annulus. Central perforations are those which cannot be classified as anterior or posterior perforation. We had 36 (31.9%) anterior perforations. Thirt-seven (32.7%) were central and 40 (35.4%) were posterior perforations table-1. We noted that among the 36 anterior perforations only 58.3% healed. While among the perforations which were central in location 94.6% healed. The healing was 87.5% in case of posterior perforations. The *p*-value was calculated and was found to be 0.000, which is very significant.

The perforation which involve the annulus are classified as marginal perforations and those which spare the annulus are called central perforations. Only 34 (30.1%) patients in our study had marginal perforations. Rest of the 79 (69.9%) patients had central perforations. The healing percentage was significantly lower for the marginal perforations, i.e., 47.1%. Only 16 out of total 34 marginal perforation healed postoperatively. While the central perforations healed in 94.9% of the cases. In this *p*-value was also 0.000 which is again 99% significant. (Table-2)

The size of the perforation was also documented. When the perforation was less than one quarter of the tympanic membrane it was termed as small. When the perforation was less than half of the tympanic membrane it was classified as medium and when it was involving more than half of the tympanic membrane it was classified as large perforation. In our study, according to this classification 28 (24.8%) were small, 61 (54%) were medium and 24 (21.2%) were large perforations. Size of perforation also affected the healing of tympanic membrane. 100% of the small perforations healed by the surgery. 80.3% of the medium perforations showed healing and in comparison, only 58.3% of the large perforations showed complete healing 6 months postoperatively. In this case *p* – value was again calculated and was 0.001. (Table-3)

These results showed that the both the site of perforation and the size of perforation have significant effect on the result of Type-I Tympanoplasty. Also, if the perforation is involving the annulus the chances of success of Type-I Tympanoplasty fall significantly.

Among the 113 patients, 6 were operated for bilateral tympanic membrane perforations. In 2 of these patients both ears healed in their respective first Type-I Tympanoplasty operations. Rest of the 4 patients each had one successful and the other unsuccessful Type-I Tympanoplasty. Out of these 4 we repeated the procedure on the unsuccessful ear in 2 patients and their perforations healed in the second surgery. This shows that revision Type-I Tympanoplasty also has good postoperative result. The procedure was repeated 9 months after the previous surgery in these patients.

Table-1: Success rate for different sites of perforation

		Healing at 6 Months		p-value
		Healed	Not healed	
Site of Perforation	Anterior	21 (58.3%)	15 (41.7%)	0.000
	Central	35 (94.6%)	2 (5.4%)	
	Posterior	35 (87.5%)	5 (12.5%)	
Total		91 (80.5%)	22 (19.5%)	

Table-2: Success rate for different types of perforation

		Healing at 6 Months		p-value
		Healed	Not healed	
Type of Perforation	Central	75 (94.9%)	4 (5.1%)	0.000
	Marginal	16 (47.1%)	18 (52.9%)	
Total		91 (80.5%)	22 (19.5%)	

Table-3: Success rate for different sizes of perforation

		Healing at 6 Months		p-value
		Healed	Not healed	
Size of Perforation	Small	28 (100.0%)	0 (0.0%)	0.000
	Medium	49 (80.3%)	12 (19.7%)	
	Large	14 (58.3%)	10 (41.7%)	
Total		91 (80.5%)	22 (19.5%)	

DISCUSSION

Tympanic membrane perforation causes a lot of problems for the patients. Most serious of these is recurrent infections of the middle ear due to absence of protection of the middle ear by the tympanic membrane.² A large majority of these patients can be treated by repairing the tympanic membrane which will seal off the middle ear from the outside thus protecting it from water entering the ear.³

After correcting nasal diseases which can cause Eustachian tube dysfunction and recurrence of middle ear infection, we treated the middle ear of all the patients for present infection. As wet ear procedures have significantly lower success rates as compared to dry ear surgery⁸ so regular check-up of these patients was done and after a period of 4 months of dry ear we did Type-I Tympanoplasty on these patients by the underlay technique. We calculated the overall success rate of Type-I Tympanoplasty in our setup.

The factors which affect the success of Type-I Tympanoplasty include the size, site and type of perforation. We have assessed all of these factors in our study.

Overall success rate of Type-I Tympanoplasty in our study was 80.5% which is comparable to most international and national studies. In a retrospective cohort analysis done in Cape Town the success rate was calculated as 71%.⁹ In Ireland, the success rate of Type-I Tympanoplasty done by traditional method was documented as 82.6%.¹⁰ In data collected only on the patients above 60 years of age the success rate was found to be 76.2%.¹¹ The graft take-rates using a prospective database were assessed and the success rate was seen to be 86.6%.¹² In another cohort study done in Mexico the success rate of Type-I Tympanoplasty was found to be only 70%.¹³ In a national study done in Lady Reading Hospital Peshawar the overall success rate was found to be 80%.³ The overall reported incidence of surgical success of repair of tympanic membrane ranges from 60–99% in adults.¹⁴ We divided our perforations according to different sites of tympanic membrane involved. They were divided into anterior, central and posterior perforations. In our case series, we concluded that central perforations had the best chance to heal. Almost 95% of the Type-I tympanoplasties done on central perforations showed complete healing within 6 months of the operation. While the anterior perforations healed in only 58.3% of the perforations healed. Different studies have been done to determine the relationship between the site of perforation and healing. In Italy, a study was done for comparing the results of underlay and on-lay techniques it was noted that all the failed cases had anterior perforations.¹ A study done in Department of Bergamo Ospedali Riuniti Italy clearly states anterior perforations as negatively influencing the success rates.¹⁵ Other results also clearly document the anterior location of the perforation as a negative prognostic factor for a successful procedure.^{16,17}

We also concluded that marginal perforations had a poor outcome and only 47.1% of the marginal perforations healed postoperatively. While the perforations in which the annulus was not involved the healing was 94.9%. In Poland, similar results were seen, i.e., 50% success rate in cases of marginal perforations.¹⁸

In the underlay technique, the perforation heals partly by the uptake of the graft and mainly by the epithelial migration from the rim of the tympanic membrane remnant¹⁴ over the graft material. So, it is obvious that large perforations will be difficult to heal. In our study, we also saw that large perforations had a successful outcome in 58.3% of the cases while

in small perforations 100% of the cases showed complete healing within 6 months of surgery. This is in comparison with a study done in Iraq in which the success rate was found to be 100% for small perforations and 76% for large perforations.¹⁴ In a meta-analysis and systematic review article it was documented that Type-I Tympanoplasty done on large perforations are more likely to fail as compared to smaller perforations.¹⁹

In some of the large perforations there is partial healing and surgeons repeat Type-I Tympanoplasty in these patients. We also did revision surgery in 2 of our unsuccessful cases and both of these healed in their second surgeries.

CONCLUSION

There is a significant association between the healing of tympanic membrane after Type-I Tympanoplasty and site, size and type of perforation. Anterior perforations, marginal perforation and large perforations significantly reduce the chances of successful outcome of Type-I Tympanoplasty.

ACKNOWLEDGMENT

Special thanks to Miss Fatima Sajid for entering all the data in SPSS, helping with searching of references and Endnote programme, citing of references, editing and proof reading the final manuscript for us.

I would also like to thank Dr. Umar Farooq for his support and guidance, without which this article would not have been successfully brought to completion.

AUTHORS' CONTRIBUTION

TS: Literature search, concept, data collection, data analysis and interpretation, write-up and proof reading. MIS: Literature search, data collection. RG and AK: Data collection.

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Received: 24 July, 2017

Revised: 12 February, 2017

Accepted: 27 February, 2017

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