

Research Article

Type I Tympanoplasty in Adolescence: Prognostic Factors and Surgical Outcomes

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Abstract

Background and objectives: Type I tympanoplasty is a common otologic surgery which aims to repair the eardrum integrity. Different views have been reported concerning this procedure in young ages and the best moment to perform surgery remains controversial. Surgery in early adolescence appears to achieve the same outcomes than adulthood and without disadvantages of childhood. Characteristics of perforation and the functioning of the Eustachian tube were proposed as determinants of prognosis; however their effect also remains unclear. This study aims to analyse the success rates of type I tympanoplasty in adolescence and ascertain the existence of variables that may predict surgery outcomes.

Subjects and methods: We present a retrospective study of 52 teenagers who undergone type I tympanoplasty, between January 2004 and December 2013. We analysed the impact of age, site, size and cause of perforation, state of middle ear and the existence of contralateral disease on anatomic and audiometric success.

Results: Our patients presented a mean age of 15.9 years. The eardrum closure was verified in 80.8% and the audiometric success was achieved in 76.9% of cases. Presence of tympanosclerosis in the middle ear and disease in contralateral ear reduced significantly anatomic and audiometric success rate.

Conclusion: Type I tympanoplasty is a surgical procedure with good results in adolescence, similar to those found in adults. Deterioration of middle ear and Eustachian tube dysfunction appear to reduce prognosis.

ABBREVIATIONS

PTA: Pure Tone Average

INTRODUCTION

Tympanoplasty is a surgical procedure performed to eradicate disease in the middle ear and to reconstruct the hearing mechanism [1]. Type I tympanoplasty is used to repair the tympanic membrane when there is an eardrum perforation and the ossicular chain is undamaged and mobile [2].

Paediatric tympanoplasty remains a controversial theme. Kotecha et al., and other authors reported a statistically significant relationship between age and the success rate of the surgery [3,4]. Tympanoplasty appears to be more successful in children over six years of age [5,6]. However, surgery before adulthood presents multiples advantages, such as: permission to practice aquatic activities; hearing improvement; existence of better cochlear reserve at younger ages; prevent possible complications

secondary to chronic otitis media; limit deterioration that chronic infection can cause to other structures in the middle ear; and reduction in the number of visits to the doctor. Thus, surgery before adulthood allows a rapid restoration of middle ear function and brings an important improvement in quality of life. However, in the literature paediatric tympanoplasty reveals a success rate ranging from 35% to 94%, below the expected rate in adulthood [7-9].

Therefore, adolescence constitutes an optimal period to perform the surgery. In these ages, tympanoplasty presents some vantages relatively to childhood, such as: better function of Eustachian tube; maturity of the immune system; low rate of re-perforation by repetitive infections of the superior respiratory tract; and more easily post-operative care than childhood. In adolescence, tympanoplasty outcomes appear to be similar to adulthood in several series [8, 10].

Surgery success was evaluated by many authors and it appears to be influenced by several conditions. The main aspects

proposed as predictive of prognosis were the age of patient, the ethology, site and size of the perforation, the condition of the middle ear and the presence of active infection at the time of surgery. The state of the contralateral ear, presence of adenoid tissue, craniofacial dysmorphias and the choice of surgical technique have also been reported as predictive of prognosis [11,12].

This study aims to analyse the anatomic and audiometric success rate of type I tympanoplasty in teenagers in our department. We also intend to identify the existence of factors that modify outcomes in this population.

MATERIALS AND METHODS

We conducted a retrospective study of patients between 13 and 17 years who underwent type I tympanoplasty, between January 2004 and December 2013, in our hospital. We exclude patients with congenital anomalies (cleft palate, syndromes), perforations of less than 6 months, patients who underwent ossiculoplasty, re-interventions and incomplete clinical records. Marginal perforations associated with cholesteatoma disease were also excluded because chronic otitis media with cholesteatoma needs a different surgical procedure and presents a worse functional prognosis.

We achieved a total of 52 cases. All the patients had chronic otitis media with perforation in *pars tensa*. A pre-operative pure tone audiometry was measured at 500, 1000, 2000, 4000 and 8000 Hz in all cases. They also underwent routine examination of haemoglobin and clotting time. All selected patients performed a type I tympanoplasty using a retroauricular approach and performing underlay technique with autologous temporalis fascia graft, the preferred approach in our service. All cases were operated under general anaesthesia. Post-operatively, they were put on antibiotic (Amoxycillin) and analgesic (Paracetamol). Patients were called for routine follow-up on 7-10th day, 3rd week, 6th week, 3rd month, 6th month and 12th month. They were defined two types of success: anatomic and audiometric. An intact graft in proper position at the end of 12th month was considered as an anatomic success. Pure tone audiometry was repeated at 3 to 6 months and 1 year after surgery. An improvement of at least 10 dB in two consecutive frequencies, compared with preoperative air conduction thresholds, was regarded as an audiometric success.

We investigated the impact of different variables on prognosis, such as: age, gender, site, size and cause of perforation, previous adenoidectomy, state of the middle ear mucosa and condition of the contralateral ear. The site of perforation was divided in anterior, inferior, posterior and subtotal. The size of perforations were classified as small ($\leq 25\%$), medium (26 to 50%) and large ($> 51\%$) on the basis of the surface area involved. In each of these groups success rates were recorded.

Statistical analysis was performed in SPSS Statistics 20.0[®] for Windows[®]. Study of outcomes was done by Chi-square test and results were compared with literature. A *p* value less than 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

A total of 52 cases that satisfied the inclusion criteria were

analysed. 25 were males and 27 were females. The mean age was 15.9 ± 1.4 years, ranging from 13 to 17 years old. There was no side predominance and bilateral perforations were confirmed in 21 cases (40%). Besides chronic otitis media, 5 patients presented otitis media with effusion and 2 patients had atelectasis in the contralateral ear. Anterior perforations were the most common, verified in 40% of patients. 11% showed a subtotal perforation and 7 patients were intervened by atelectasis. Medium size perforations were found in 44% of cases. Regarding the ethology of the disease, 73% result from recurrent acute otitis media, 19% secondary to prior placement of the ventilation tubes, 4% due to ear trauma and 4% of unknown origin. In our series pre-operative audiometry revealed a pure tone average (PTA) of 38dB. Regarding the middle ear, 21% presented hyperplastic mucosa and 14% tympanosclerosis in the middle ear (Table 1). 16 patients undergone adenoidectomy in the past. Surgical closure of eardrum was observed in 42 ears, with a success rate of 80.8%. Improvement of at least 10 dB in two consecutive frequencies was verified in 40 cases, resulting in an audiometric success of 76.9% (Table 2). Post-operative audiometry revealed a PTA of 26dB. There was not statistically significant relationship between anatomic or audiometric success and the age, gender or affected side. Patients with disease in the contralateral ear showed a closure rate of 68%, significantly lower ($p < 0.05$) than patients

Table 1: Characteristics of the ear.

	N	%
Site of perforation		
Anterior	21	40.4%
Inferior	15	28.8%
Posterior	4	7.7%
Subtotal	5	9.6%
Without perforation	7	13.5%
Size of perforation		
Small ($\leq 25\%$)	16	30.8%
Medium (26 to 50%)	23	44.2%
Large ($> 51\%$)	13	25.0%
Cause of perforation		
Acute otitis media	38	73%
Prior placement of ventilation tubes	10	19%
Ear trauma	2	4%
Unknown origin	2	4%
State of the middle ear mucosa		
Normal	34	65%
Hyperplastic mucosa	11	21%
Tympanosclerosis	7	14%

Table 2: Success rates in type I tympanoplasty.

	n	%
Anatomic success		
Closure of perforation	42	80.8
No	10	19.2
Audiometric success		
Improvement ≥ 10 dB in 2 consecutive frequencies	40	76.9
No	12	23.1

Table 3: Prognostic factors of anatomic and audiometric success.

	Anatomic success (%)	p	Audiometric success (%)	p
Age				
13 - 14 years	9/11 (81.8%)	0.921	9/11 (81.8%)	0.664
15 - 17 years	33/41 (80.5%)		31/41 (75.6%)	
Cause of perforation				
Acute otitis media	31/38 (81.6%)	0.807	30/38 (78.9%)	0.568
Ventilation tubes / Ear trauma / Unknown origin	11/14 (78.6%)		10/14 (71.4%)	
State of the middle ear mucosa				
Normal	30/34 (88.2%)	0.021	29/34 (85.3%)	0.049
Hyperplasic mucosa	9/11 (81.8%)		8/11 (72.7%)	
Tympanosclerosis	3/7 (42.9%)		3/7 (42.9%)	
Contralateral ear				
Disease	19/28 (67.9%)	0.011	18/28 (64.3%)	0.019
Normal	23/24 (95.8%)		22/24 (91.7%)	

with normal contralateral ear (96%). Audiometric success also appeared to be better in patients with healthy contralateral ear ($p < 0.05$). Aetiology, site and size of perforation did not alter the prognosis in our study ($p > 0.05$). Presence of tympanosclerosis in middle ear reduced anatomic and audiometric success with statistical difference ($p < 0.05$) (Table 3).

The ideal age to preform tympanoplasty remains a controversial subject among the otolaryngologists. Despite the different opinions, this procedure has increased in younger ages. Our service usually delays timpanoplasty for adolescence. We found 52 type I tympanoplasties with ages between 13 and 17 years old.

In our series, all patients were intervened by retroauricular route, which allows good visualisation of the tympanic membrane. In published data was not identified significant difference between transmeatal and retroauricular route [13]. Several types of grafts have been reported in tympanoplasty, although temporal fascia is the most common. We used temporal fascia in all analysed cases and the graft was placed medial to remaining tympanic membrane. We prefer underlay technique to avoid blunting and iatrogenic cholesteatoma [14].

Our revision revealed an anatomic success rate of 80.8%, with closure of 42 in 52 cases. Different authors reported variable results due to large heterogeneity of the reported cases, with different ages, approaches, surgical techniques and graft materials. Halim et al., reported 78.9% of success, Knapik et al., verified 84.9% and Umaphy et al., described integrity of graft in 88% in patients with similar mean age [9,13,15]. These results are similar to those achieved in adult tympanoplasty, with an expected closure rate of 80% to 90% [10]. In our study, audiometric success was previous established as an improvement of at least 10 dB in two consecutive frequencies and it was verified in 40 cases, with a success rate of 76.9%. There are other acceptable definitions of audiometric success published in the literature, justifying the wide range of results in different series, ranging from 60% to 100%.

Nowadays, the best age to perform surgery is the main doubt. In our study, we achieved a mean age of 15.9 years. The majority of our cases had more than 14 years, which represents

the trend of our service to do this surgery at older ages, waiting for the maturity of the Eustachian tube and the immune system. Strong and Raine et al., suggested delay the intervention to patients older than 12 years, waiting for better results. Vrabec et al., described a relation between better eardrum cicatrisation and older ages [16-18]. In our series, when we compered the anatomic and audiometric success rates of patients aged from 13 to 14 years and those aged from 15 to 17 years, we found no statistically significant difference (Table 3). These results are in accordance to multiple studies published in literature, reinforcing the possibility to perform this surgery in early adolescence with same results than adults.

Eustachian tube function occupies a central role in ear pathology. Ophir et al. m reported that methods to evaluate tubal function are not accurate, reliable and reproducible [19]. In daily clinical practice, the state of contralateral ear appears to constitute an indirect way to predict functionality of Eustachian tube. Many authors reported that good tubal function is an important factor of good prognosis in tympanoplasty [11,19]. In this work, we verified that 28 patients present bilateral disease, including 5 patients with otitis media with effusion and 2 patients with eardrum atelectasis, suspecting tubal dysfunction. We found better anatomic and audiometric success rates in patients with normal contralateral ear, probably because these patients had better Eustachian tube function (Table 3).

Other factors have been proposed as predictive of prognosis in tympanoplasty, however the results are not consistent in different series [17,20]. Anterior, larger or subtotal perforations were associated with poor outcomes by some authors. Chronic otitis media with frequent suppuration and secondary changes in middle ear mucosa or presence of tympanosclerosis were also related with worse surgical results [17,18,20]. We evaluated 52 cases and we did not find statistical significant association between site, size or cause of perforation and the anatomic or audiometric success. On the other hand, tympanosclerosis in middle ear significantly decreased the surgical outcomes (Table 3).

CONCLUSION

Type I tympanoplasty in adolescence shows good outcomes

with a closure rate of 80.8% and an audiometric success of 76.9%. Surgery in younger patients seems to have similar results than those found in adults. Eustachian tube dysfunction and presence of tympanosclerosis in the middle ear appear to reduce success rates. However, more studies are needed to confirm the effect of these variables and to understand the advantages of surgery at even earlier ages.

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