

# Audiological Evaluation of Children below 14 Years Undergoing Tympanoplasty in a Tertiary Teaching Hospital

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## Abstract

**Introduction:** Chronic suppurative otitis media (CSOM) is at a higher incidence in the pediatric population when compared to adults. CSOM results in conductive deafness resulting in difficulty in learning speech skills. Surgical procedures to correct the hearing loss are regarded both by surgeons and parents to give poor results. Selection of children with CSOM developing speech problem and appropriate tympanoplasty in skilled hands will result in post-operative auditory gain.

**Aims:** To study the audiological results in children following tympanoplasty procedures in a tertiary teaching hospital.

**Materials and Methods:** A total of 85 children aged 9-14 years underwent tympanoplasty procedure between October 2015 and April 2017 was included in the study. Post-operative audiological evaluation, perforation closure, factors playing a role in the success rate were recorded and analyzed.

**Results:** Closure of perforation was successful in 92.94% of the children. Graft take failure occurred in 7.05% (6). Auditory gain of 30-35 dB in air conduction (AC) was found in 77.64% (66) and closure of a-b gap 20-30 dB was observed in 82.35% (70). 17.64% (15) children showed AC auditory gain of 20-30 dB, closure of a-b gap of 10-20 dB in 20% (17). No improvement in hearing was found in 4 (4.70%) children.

**Conclusion:** Tympanoplasty improves hearing in children with CSOM if performed properly. As the follow-up in the study is only 14 months, a study with a longer follow-up would suggest a definitive conclusion.

**Key words:** a-b gap, Air conduction, Auditory gain and myringoplasty, Chronic suppurative otitis media, Tympanoplasty

## INTRODUCTION

Tympanoplasty in children is considered by many surgeons and parents as less successful than in adult patients.<sup>1</sup> Prior treatment of adenoiditis and chronic tonsillitis is mandatory in children undergoing tympanoplasty.<sup>2</sup> The higher incidence of otitis media in the pediatric population is often implicated as the reason for poorer results.<sup>3</sup> There are diverse opinions among the surgeons concerning the right indications for tympanoplasty

in children.<sup>4</sup> Many would agree and go ahead with surgery in children with cholesteatoma de novo or with complications.<sup>5</sup> The chronically draining ear that is resistant to medical therapy also requires surgery.<sup>6</sup> Few surgeons advocate early surgery to correct anatomic defects and improve hearing so that their language skills are not affected. Others maintain elective surgery should be deferred until the peak incidence of acute otitis media has passed.<sup>7</sup> Pediatric myringoplasty were performed as early as 1962 in the United States<sup>8</sup> (1) and in the early 1970s in the United Kingdom (2).<sup>9</sup> Literature in English journals quote success rate of 56-94% in children undergoing myringoplasty (3).<sup>10</sup> The difference in success rate may be due to dissimilarity in study design and selection of cases and criteria for success rate.<sup>10</sup> Nevertheless, a meta-analysis concluded that there was no difference associated with age in the success rate of myringoplasty.<sup>11</sup> The aim of present study was to study

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**Month of Submission :** 04-2017  
**Month of Peer Review :** 05-2017  
**Month of Acceptance :** 06-2017  
**Month of Publishing :** 06-2017

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audiological results in children following tympanoplasty procedures in a tertiary teaching hospital.

## MATERIALS AND METHODS

A total of 85 children attending the ENT Department of a tertiary teaching hospital attached to NRI College, Guntur of Andhra Pradesh, India with diagnosis of chronic suppurative otitis media (CSOM) were included in the present study. An approval from the Institutional Ethical Committee of the college was obtained. An ethical committee approved consent form was used during the study.

### Inclusion Criteria

1. Children aged between 9 and 14 were included.
2. Children with the diagnosis of CSOM (safe and unsafe) were included.
3. Children with delayed language development were included.
4. Children with purely conductive deafness were included.
5. Children operated earlier for adenoidectomy and tonsillectomy were included.
6. Children with normal X-ray paranasal sinus were included.

### Exclusion Criteria

1. Children below 9 years and above 14 were excluded.
2. Children with sensorineural hearing loss were excluded.
3. Children with a history of using aminoglycosides in their earlier medical history were excluded.
4. Children with chronic adenoiditis and chronic tonsillitis were excluded.

Parents of the children were interviewed to elicit the mispronounced consonants and vowels and their number. A thorough history was taken, ear-nose-throat examination and endoscopy of ears and nasal cavity was done. All the children were subjected to pure tone audiometry using 500, 1000, 2000, and 4000 Hz stimuli and pure tone average (PTA) was calculated; the data collected were classified according to the loss in air conduction (AC) and level of a-b gap in dB. All the children with CSOM (unsafe) with cholesteatoma limited to auditus ad antrum without involvement of attic and mastoid antrum proper were performed intact canal wall mastoidectomy. Canal wall down was done in children with extensive cholesteatoma in attic, antrum, and middle ear. Children with safe type were performed cortical mastoidectomy with tympanoplasty. Post-aural approach was used in all operations. The temporalis fascia graft was harvested and positioned medial to the drum remnant using the underlay technique. A post-operative audiometry was done after 2 months in case of

safe type and after 4 months in case of canal wall down procedures and PTA calculated. All the data were analyzed using standard statistical methods.

## RESULTS

The mean age of children in the study group was  $12.45 \pm 2.30$ . There were 63 (74.11%) male children and the remaining were females 22 (25.88%). Children aged 9-11 years were 31 (36.47%) and children belonging to 12-14 years were 54 (63.52%). Children with CSOM (safe) were 69 (81.17%) and children with CSOM (unsafe) were 16 (18.82%). Children with CSOM (safe) were having relatively dry ears for 2 months before surgery unlike CSOM (unsafe). All the children of the study group were operated on only one ear. Among the 85 children, 23 (27.05%) had bilateral CSOM. Audiometry showed that children with AC thresholds between 40-50 dB were 34 (40%) and 20-40 dB were 51 (60%). Children with a-b gap of 25-35 dB were 46 (54.11%) and a-b gap 15-25 dB was 39 (45.88%). The ossicular status during the surgery was noted and found that children with CSOM (unsafe) had ossicular necrosis involving incus alone in 9/16 (56.25%), incus and malleus erosion in 5/16 (31.25%), and in 2/16 patients (12.5%) only stapes footplate was found (Table 1).

Successful closure of perforation was defined as an intact eardrum at 1-year post-operatively. Success in terms of improvement in hearing was defined as an improvement of 10 dB or more in two consecutive frequencies compared with the Pre-operative AC thresholds<sup>11</sup>. The success rate was 51/54 (12-14 years age) 94.44% and 28/31 (90.32%) in children aged 9-11 years. Failure of the graft occurred in 6 patients (7.05%) (Table 2).

**Table 1: The age, type of CSOM, side of involvement, and audiometry data (n=85)**

Observation	Male (63)	Female (22)
9-11 years (n=31)	22	09
12-14 years (n=54)	41	13
CSOM (safe) (n=69)	54	15
CSOM (unsafe) (n=16)	09	07
Unilateral (n=62)	49	13
Bilateral (n=23)	14	09
Pre-operative AC threshold - 40-50 dB (n=34)	23	11
Pre-operative AC threshold - 20-40 dB (n=51)	40	11
Pre-operative a-b gap - 25-35 dB (n=46)	38	08
Pre-operative a-b gap - 15-25 dB (n=39)	25	14
Incus erosion - 9/16	05	04
Incus and malleus erosion - 5/16	03	02
Incus, malleus, and stapes supra	01	01
Stapes suprastructure. - 2/16		

CSOM: Chronic suppurative otitis media, AC: Air conduction

Auditory gain of 30-35 dB in AC was found in 77.64% (66) and closure of a-b gap 20-30 dB was observed in 79.01% (64). 17.64% (15) children showed AC auditory gain of 20-30 dB, closure of a-b gap of 10-20 dB in 20.98% (17). No improvement in hearing was found in 4 (4.70%) children. Few factors observed and predicted that they contributed in the outcome of tympanoplasty were the duration of dryness of ear, canal wall down or up procedure (Table 3).

## DISCUSSION

CSOM with conductive deafness in children causes significant disability in day-to-day activities as well as learning of speech. Tympanoplasty is a simple and effective procedure that can reverse the process of hearing disability resulting in the successful closure of the perforation in most cases and improving hearing. However, there seems to be no consensus among otologists regarding the benefits of tympanoplasty in children.<sup>12-14</sup> The advantages of early surgery are to prevent developing chronic ear disease; related complications, to improve hearing without the need for a hearing aid and thus, aid speech and language development and to help the child enjoy water activities. The possibility of existing persistent eustachian tube (ET) dysfunction, recurrent upper respiratory tract infections, surgical technical difficulty, and re-perforation are the factors deterring the surgeon to operate until a certain age.<sup>14</sup> This age could vary from 10 to 14 years. It has also been argued that a perforation in the eardrum is an equivalent to a ventilation tube.<sup>12</sup> The age at which the child should be operated is controversial. Glasscock<sup>15</sup> considered young age as a relative contraindication to tympanoplasty because children below 3 or 4 years age prone to recurrent upper respiratory infections and otitis media. Koch *et al.*<sup>12</sup>

five reported 81% success rate in children aged eight and above; a 30% success rate in children younger than 8 years. They concluded that tympanoplasty before age eight results in a high rate of failure because of poor ET function and frequent uniform resource identifiers. Smyth<sup>16</sup> noted that patients below 10 years had a higher failure rate for tympanoplasty than older children. This observation was independent of type of secretion, perforation site, and graft material. Lau and Tos<sup>17</sup> found no significant difference in success rates between the two and seven age group and those children aged 8-14. They suggested that early operation may prevent progression of ossicular chain resorption. Ophir *et al.*<sup>18</sup> reported 79% overall success rate, and their success in younger children<sup>5-8</sup> was comparable to the rate for older children. They concluded that tympanoplasty had a good chance of success at any age. Kessler *et al.*<sup>13</sup> in the review of their 209 surgeries concluded that even in young patients (2-6 years) tympanoplasty had a higher success rate (75-94%) and that age alone could not be considered a contraindication to surgery. Hence, the outcome of Tympanoplasty depends on criteria for selection and the length of follow-up. If closure of perforation alone is taken as a measure of success, the rate is reported to be between 75% and 92%.<sup>18</sup> This compares favorably with the results reported for the adult population.<sup>19,20</sup> However the success rate can be as low as 45% when post operatively conditions like glue ear, reinsertion of ventilation tubes followed by electrostatic of middle ear occur and should be considered causes of failure<sup>12,18</sup>. Even though the sporting life of children improves with simple healed graft avoiding contamination of the middle ear cleft and recurrent otorrhea, there is no scale to measure the improved quality of life. This makes it crucial to define the criteria of success in pediatric tympanoplasty, preferably internationally, to enable every surgeon to compare the results in a more meaningful way. In the present study, patients aged 9-14 years were included with a result of successful graft uptake was 92.94% comparable to the results of various authors.<sup>11,12,21,22</sup> The reason for variation in results of these authors could be attributed to the wide range of age that differs in various studies, because of technique used, varying length of follow-up, and experience of surgeons. Auditory gain of 30-35 dB in AC was found in 77.64% (66) and closure of a-b gap 20-30 dB was observed in 79.01% (64). 17.64% (15) children showed AC auditory gain of 20-30 dB, closure of a-b gap of 10-20 dB in 20.98% (17). No improvement in hearing was found in 4 (4.70%) children. The causes of failure in graft healing in six children and failure in auditory gain in four children among the children with healed grafts were developing measles in one child, failure to use antibiotics in two children and children going to swimming within 4-week post-operatively in the remaining three children.

**Table 2: The success rate according to the age group (n=85)**

Age	Male (63)	Female (22)
12-14 years - 51/54 (94.44%)	41	13
09-12 years - 28/31 (90.32%)	22	09

**Table 3: Auditory gain in children of the study (n=85)**

Auditory gain	Male	Female
AC gain; 30-35 dB (n=66) (77.64%)	52	14
AC gain; 20-30 dB (n=15) (17.64%)	07	08
a-b gap closure; 20-30 dB (n=64) (79.01%)		
a-b gap closure; 20-30 dB (n=17) (20.98%)		

AC: Air conduction

## CONCLUSION

Tympanoplasty procedure is beneficial in children when performed by experienced surgeon. Proper selection of the patients, undertaking adenoidectomy, and tonsillectomy wherever indicated before tympanoplasty makes the surgery more successful. It stands a good chance in restoring hearing in children. However, a bigger study with a long follow-up is necessary to conclude definitely.

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**How to cite this article:** Sateesh N, Yarlagadda S. Audiological Evaluation of Children below 14 Years Undergoing Tympanoplasty in a Tertiary Teaching Hospital. *Int J Sci Stud* 2017;5(3):125-128.

**Source of Support:** Nil, **Conflict of Interest:** None declared.