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Pediatric Tympanoplasty Type I (Cartilage Vs Temporalis Fascia Graft)

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Abstract:

Aims: *Comparative study of cartilage and temporalis fascia graft in pediatric tympanoplasty regarding graft uptake and hearing improvement.*

Materials and methods: *This study was conducted in our institution between 2010 to 2013. All patients were in the age group 9-13 years having chronic suppurative otitis media with perforation in the pars tensa. The patients for the study were selected on the basis of inclusion and exclusion criteria. All patients underwent tympanoplasty type I under general anesthesia via retroauricular approach. Patients were divided into Group A. Tympanoplasty using tragal cartilage island graft. Group B. Tympanoplasty using temporalis fascia graft with 40 patients in each group. Data regarding successful perforation closure and hearing improvement were recorded and final assessment made at 6 months.*

Results: *The overall perforation closure was 88.75%. In cartilage island group it was 95% and in temporalis fascia group 82.5%. Residual perforation was seen in 9 cases, 2 in cartilage island group and 7 in temporalis fascia group. Regarding age, children 9-11 years had better outcome concerning anatomical success with cartilage island graft than temporalis fascia graft with statistical significance (p=0.04). Although better anatomical results were observed in 11-13 years with cartilage island graft than temporalis group, but we did not find any statistical significance. Audiological improvement was 11.3 dB. The mean AB gap gain in the cartilage island group was 9.8 dB and in the temporalis fascia group it was 12.2 dB. There was no difference between the audiologic outcome after paediatric tympanoplasty in both groups.*

Conclusion: *Both cartilage and temporalis fascia graft provides good anatomical and audiological results in children. Cartilage tympanoplasty in pediatric age group (9-11 years) has an additional advantage of improvement in long term closure of the tympanic membrane in comparion to temporalis fascia graft.*

Keywords: *middle ear disease, tympanoplasty, temporalis fascia graft, cartilage graft,*

I. Introduction

The tympanic membrane plays a significant role in the physiology of hearing as well as in the pathophysiology of chronic inflammatory middle ear diseases and its perforations significantly impair the quality of life for millions of patients.[1] The potential seriousness of ear suppuration was first appreciated by 'Hippocrates' but the idea of operating to relieve the condition was first given by the great medieval surgeon Ambrose Pars.[2]

'Tympanoplasty' implies reconstruction of the tympanic membrane with eradication of middle ear disease and reconstruction of hearing mechanism[3]. Type I typmpanoplasty is the repair of TM with inspection of middle ear. Traditionally, tympanoplasty was not recommended in children younger than 7 years because it may affect the normal growth of the bony external canal, and because it was thought to have a high rate of recurrence owing to immature Eustachian tube function. Several studies have shown that tympanoplasty even in children as young as 2 and ½ years old, has a good success rate and long term stability. Pediatric tympanoplasty is a frequently performed procedure nowadays with varying reported success rates ranging between 35 and 94%. Previously quoted reasons for the poorer success rate include: frequent upper respiratory tract infections, persistent otitis media and ongoing Eustachian tube dysfunction, and inconsistent postoperative care.[4]

Temporalis fascia is most commonly used graft. Others include perichondrium from tragus, cartilage from tragus and concha, areolar tissue and fat from ear lobule, vein, cadaveric tympanic membrane, cadaveric pericardium, formalin preserved cadaveric temporalis fascia and cadaveric sclera[5]. The most frequently used

technique for the repair of tympanic membrane perforation is underlay grafting. Graft choice in pediatric tympanoplasty (fascia versus cartilage) has not been examined to the extent that it has in the adult population where its use has been justified by excellent outcomes in numerous reports.[4] The purpose of this study is to know about the result of pediatric tympanoplasty using cartilage and temporalis fascia graft.

Temporalis fascia is the most frequently used grafting material with high success rate of approximately 85-90%. In cases of subtotal perforations, atelectatic ear, retraction pocket, ossiculoplasty or mastoid surgery long term results of temporalis fascia graft may not be very satisfactory.[6,7] Using a more rigid grafting material such as cartilage may help avoiding such failures. Nevertheless there may be some concern regarding poor hearing using this grafting material rather than fascia. The use of cartilage has been recommended on a limited basis to manage retraction pockets and high risk perforations. The cartilage was first used to rebuild the ossicular chain in 1958, by Jansen[8]. Some years later, this material began to used as a graft in tympanoplasty, especially in cases of advanced middle ear diseases, because of their robustness, offering greater resistance to resorptions[9]. Cartilage contributes minimally to an inflammatory tissue reaction and is well incorporated with tympanic membrane layers; it also provides firm support to prevent retraction. The perceived disadvantage of the cartilage graft is that it creates an opaque tympanic membrane, which could potentially hide a residual cholesteatoma.

II. Materials And Methods

This study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, ST. STEPHEN'S HOSPITAL, DELHI between 2010 to 2013. All patients were in the age group 9-13 years having chronic suppurative otitis media with perforation in the pars tensa. The patients for the study were selected on the basis of inclusion and exclusion criteria. Inclusion criterias include patients of either sex in the age group of 9-13 years, having good general physical condition, no evidence of active infection in nose, throat or paranasal sinuses, dry ear for a minimum period of 3 weeks before the day of operation with good cochlear reserve. Patients having polyp, granulations or cholesteatoma, failed myringoplasty in the same ear, with otogenic intra cranial complications in the past, evidence of otitis externa or otomycosis, per operative ossicular discontinuity, fixed foot plate, any pathology in nose, throat or nasopharynx and any skin disease in the post aural region, temporal region or in the skin of face in front of ear were excluded from the study.

Auditory function was analysed by performing preoperative and postoperative tuning fork test (256, 512, 1024 hz) and pure tone audiometry. All patients underwent tympanoplasty type I by the same team under general anesthesia via retroauricular approach. Study groups were divided into 2. A. Tympanoplasty using tragal cartilage island graft. B. Tympanoplasty using temporalis fascia graft. 40 patients were present in each group.

Group 'A': The cartilage island flap was harvested from the tragus. Incision was given over the skin of the medial side of the tragus. A piece of cartilage, with attached perichondrium, was dissected free. A complete strip of cartilage was then removed vertically from the center of the cartilage to accommodate the entire malleus handle. The cartilage was used as a full thickness graft and slightly less than 1 mm thick in most cases. Flap of perichondrium was produced posteriorly that will eventually drape the posterior canal wall. Graft was placed by underlay technique. Gel foam was packed in the middle ear space under the annulus to support the graft. External ear canal was packed with gel foam.

Group 'B' Temporalis fascia graft was be harvested by the postauricular William Wilde's approach. A self retaining mastoid retractor is placed in. upper part of the incision and further retraction of the upper most part of the incision is done by a double hook retractor. Blunt dissection was carried out until temporalis fascia was reached. The fascia of adequate size was removed using scissors. Using the underlay technique, graft was placed below the handle of malleus. External ear canal was packed with gel foam.

In both groups, external ear canal was cleaned of gel foam after 21 days and status of the graft and the tympanic membrane assessed. Anatomical success of tympanoplasty was defined as an intact graft without lateralization, retraction, inflammation or infection at the last follow-up visit with a minimum of 6 months. Hearing assessment was done at 12 weeks and again at 6 months. Postoperative pure-tone audiometric findings of the patients were obtained and hearing differences at 250, 500, 1000, 2000, and 4000 Hz were assessed. Audiological outcome was assessed by gain in AB gap. Student's t test was used for the statistical analysis. The difference would be accepted as statistically significant if the value of p was <0.05.

III. Result

The study group consisted of 80 patients, divided randomly into two groups with equal subject count (n=40), namely Group A and Group B. Each group was matched for age and size of perforation. In group A tragal cartilage and in the group B temporalis fascia was used as graft material. Each group underwent underlay tympanoplasty. The patients were kept in follow up for a minimum of 6 months. There were 16 males and 24 females in the cartilage island group and 18 males and 22 females in the temporalis fascia group. In the cartilage

island group 57.5% of patients were operated in the left ear and 42.5% in the right ear. In the temporalis fascia group 47.5% of patients were operated in left ear and 52.5% in the right ear.

Anatomical Success:

The age of the patient was between 9-13 yrs. In cartilage group 47.5% patients were between 9-11 years while 52.5% in 11-13 years. In temporalis fascia group, 35% patients are in the age group of 9-11 years while 65% in 11-13 years. The overall perforation closure was 88.75%. in cartilage island group it was 95% and in temporalis fascia group 82.5%. Residual perforation was seen in nine cases, 2 in cartilage island group and 7 in temporalis fascia group.(table 1)

Regarding age, children 9-11 years had better outcome concerning anatomical success with cartilage island graft than temporalis fascia graft with statistical significance (p=0.037). Although we did not find any statistical significance (p=0.83) in 11-13 years with cartilage island graft than temporalis group, but In order of frequency, the perforation was grade III in 45%, grade IV in 22.5%, grade II in 22.5% and grade I in 10% in cartilage island group. While in temporalis fascia group, perforation was grade I in 35%, grade II in 27.5%, grade III in 22.5% and grade IV in 15% patients. No statistical correlation was found between the type of graft used (cartilage and temporalis fascia group), grade of perforation and graft uptake.(table 2)

Audiological Outcomes:

All the 80 patients had history of loss of hearing. Table 3 showed preoperative and postoperative audiologic results for all patients in the study. Majority of patients in both groups i.e. 60% in cartilage island group and 47.5% in temporalis fascia group had pre op AB gap in the range of 21-30 dB. 6 months after surgery, around 90% had AB gap within 20 dB in both groups. 65% had AB gap of <10 dB in temporalis fascia group and it was 52,5% in cartilage island group. (Table 3). Gain in AB gap was shown in table 4. Mean audiological improvement was 11.3 dB. The mean gain in AB gap in the cartilage island group was 9.8 dB and in the temporalis fascia group it was 12.2 dB. Standard deviation of gain in AB gap in the temporalis fascia group is ± 6.66 and in cartilage island group it was ± 6.37. This analysis showed no significance and confirms no difference between the audiologic outcomes after paediatric tympanoplasty using cartilage island graft and temporalis fascia graft.

IV. Discussion

Management of tympanic membrane perforations in pediatric population is a common challenge and optimization of surgical technique for repair of these perforations is an ever-emerging field. Otologic surgery in children is regarded by many as being less successful than in adult patients. Success rate of pediatric tympanoplasty vary throughout the literature. The difference is partly explained by differences in the inclusion and exclusion criteria and definitions of anatomical and audiological success and the length of follow-up. It creates big confusion for both parents and medical professionals as there is no precise selection criteria regarding timing and indications for pediatric tympanoplasty.

Timing of repair of tympanic membrane perforation in pediatric population is very controversial and is a main topic of discussion. In our study, the mínimum range stood at 9 years but we did not found any statistically significant differences compared to older age groups (13 years). The source of conflict lies in the age of maturity of the Eustachian tube. Some advocate surgery at any age, while others advise postponing intervention in elective cases until a given age is attained. Even the age at which surgery becomes advisable varies considerably. MacDonald et al[10] recommend avoiding surgery before age 7 years, Koch et al[11] suggest waiting to age 8 years, Shih et al[12] favor age 10 years, and Raine and Singh[13] prefer age 12 years. Kessler et al[14] found no difference in short-term success rates but noted a greater incidence of reperforation in children younger than 6 years. Ophir et al[15] find no difference.

Graft choice in pediatric tympanoplasty (fascia versus cartilage) has not been examined to the extent that it has in the adult population. Temporalis fascia is still the most commonly used graft in all type of cases, though many study concluded that the result of cartilage tympanoplasty is as good as temporalis fascia graft. One possible source of hesitation in routinely using cartilage for pediatric tympanoplasty is the limited data available on the long-term outcomes and collective uncertainly regarding the appropriate timing of tympanoplasty relative to age. Thus, the purpose of this study is to explore long-term pediatric cartilage and temporalis fascia tympanoplasty outcomes with particular attention given to age and grade of perforation and improvement in hearing.

Cartilage has been successfully used in middle ear procedures for first time used by Jansen and Salen. It has been shown in both clinical and experimental studies that cartilage is well tolerated with minimal resorption time and survives for a long period with good hearing results. Although one might anticipate a significant conductive hearing loss with cartilage owing to its rigidity and thickness, several studies showed that hearing results with cartilage were not different than those with fascia. As it is becoming more clear that the use

of cartilage as a grafting material for tympanoplasty results in improved repair rates while avoiding significant impairment in hearing outcomes as compared to fascia, cartilage tympanoplasty appears to be becoming more common in children. Possible benefits of cartilage grafts over fascia in pediatric age group that may account for improved outcomes include a relative tendency to rigidly fixate and avoid medial migration during the postoperative healing phase as well as a tendency to resist re-retraction when underlying Eustachian tube dysfunction is pervasive.

In trying to delineate whether cartilage is preferable to fascia specifically in the pediatric population, a recent literature review by Nicholas et al[16] found only four studies examining results of pediatric cartilage tympanoplasty. Success rates ranged from 71-100. Eavey examined this technique in 11 patients from the age of 6 to19 and had a graft closure rate of 100%.[17] Couloigner et al. compared inlay cartilage grafting to an underlay fascia tympanoplasty technique in patients ranging from age 3 to 17 and noted no significant difference in outcomes between the two techniques.[18]

Age as a prognostic factor in pediatric tympanoplasty is controversial. Vrabec et al performed a meta-analysis of pediatric type I tympanoplasty and noted greater success with advancing age. Yet, similar to the findings in the current study, Yung et al[19], Merenda et al[20], and Umapathy and Decker[21] all did not find age to impact cartilage tympanoplasty outcomes. In our study, graft uptake was statistically better using cartilage island graft than temporalis fascia graft in pediatric tympanoplasty especially in 9-11 years age group. There was no statistical significance in graft uptake between younger and older patients among cartilage tympanoplasty group.

The overall perforation closure was 88.75% in pediatric tympanoplasty as compared to many authors. Al khtoum et al[22] (85.7%), Castro et al[23] (84%), Singh et al[24] (80%), Umapathy[25] (90%) had success rate in closure of perforation in pediatric patients.

Grade of perforation is thought to play a role in determining the success of tympanoplasty. It is believed that large perforations are often associated with lower success rate by some authors. However, for others, the grade of perforation does not correlate with the success rate of the operation. Similarly to the our study no statistical correlation was found between the type of graft used (cartilage and temporalis fascia group), grade of perforation and graft uptake.

Post-operatively, audiological success criteria have not yet been standardized. In this study we relied on AB gap improvement. ABG reduction varies in the literature between 7.6 db and 12.6dB. In our study the mean audiological improvement was 11.3 dB comparable to Al khtoum et al[22] (11.4), Castro et al[23] (12.53), Knapik et al[26] (9.1). The mean gain in AB gap in the cartilage island group was 9.8 dB and in the temporalis fascia group it was 12.2 dB. This analysis showed no significance and confirms no difference between the audiologic outcomes after paediatric tympanoplasty using cartilage island graft and temporalis fascia graft.

V. Conclusion

This study shows that tympanoplasty is a valid treatment modality for tympanic membrane perforation and hearing outcome in the pediatric population. Both cartilage and temporalis fascia graft provides good anatomical and audiological results in children. Cartilage tympanoplasty in pediatric age group (9-11 years) has an additional advantage of improvement in long term closure of the tympanic membrane in comparion to temporalis fascia graft.

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Table 1:

Age	Type of Graft used	Total Cases Done	Failure rate
09 to 11	Cartilage Graft	19	1
	Temporalis Fascia Graft	14	6
11 to 13	Cartilage Graft	21	1
	Temporalis Fascia Graft	26	1

Table 2:

Grade Of Perforation	Type of Graft used	Total Cases Done	Failure rate
I	Cartilage Graft	4	0
	Temporalis Fascia Graft	14	1
II	Cartilage Graft	9	0
	Temporalis Fascia Graft	11	2
III	Cartilage Graft	18	1
	Temporalis Fascia Graft	9	2
IV	Cartilage Graft	9	1
	Temporalis Fascia Graft	6	2

Table 3:

AB GAP (dB)	Pre Operative		Post Opearative	
	Cartilage Graft	Temporalis Fascia Graft	Cartilage Graft	Temporalis Fascia Graft
0 to 10dB	0	1	21	26
11 to 20dB	10	16	25	11
21 to 30dB	24	19	3	3
31 TO 40dB	6	4	1	2

Table 4:

Hearing Status	Gain in AB gap (dB)	0 TO 10	11 TO 20	21 TO 30	31 TO 40
Type of Graft used	Cartilage Graft	11	23	6	0
	Temporalis Fascia Graft	16	17	7	0