COMBINED USE OF FASCIA TEMPORALIS AND CARTILAGE IN PEDIATRIC TYPE 1 TYMPANOPLASTY AT DIAMNIADIO CHILDREN'S HOSPITAL

[1]Sall A. C., [2]Deguenonvo R.E.A., [1]Sy A., [1]Ba P.Y., [1]Ndiaye M., [3]Diallo BK
[1]Departments of Otorhinolaryngology and Head and Neck Surgery, Children's Hospital of Diamniadio, Senegal, [2]Idrissa Pouye General Hospital, Senegal, [3]Albert Royer Children's Hospital, Senegal.

ABSTRACT

Introduction: *Fascia temporalis is the most commonly used graft in tympanoplasty type 1. Our study describes the composite grafts with temporal fascia and cartilage. It aims to report our anatomical and functional results with this technique*
.
Patients and Method: *This is a retrospective study between January 2017 and December 2020, conducted in the ENT department of the Diamniadio Children's Hospital (SENEGAL).*

Results: *There were 37 patients, consisting of 19 girls and 18 boys in the age group of 7-15 years. Thirty-two tympanic perforations were sequelae of chronic otitis media, and 5 were post-traumatic. All patients underwent tympanoplasty type 1 under general anesthesia with a retroauricular approach with combined use of fascia temporalis and cartilage. The percentage of graft intake was 89%, and the average gain in air conduction was 12 decibels.*

Conclusion*: In our clinical practice, the combined use of cartilage and fascia temporalis provides good anatomical and functional results in pediatric type 1 tympanoplasty*.

Keywords: *Tympanoplasty, Fascia temporalis, cartilage, child*

INTRODUCTION

Type I tympanoplasty is the repair of the tympanic membrane (TM) with inspection of the middle ear. Since the introduction of tympanoplasty by Wullstein in 1952[1] and Zollner in 1955,[2] different types of graft materials have been used to reconstruct the TM. These include fascia temporalis, skin, periosteum, perichondrium, dura mater, cartilage, vein, and fat.[3, 4] Fascia temporalis is the most commonly used graft. Pediatric tympanoplasty is a frequently performed procedure with varying reported success rates ranging between 35 and 94%.[5]

In our department, before 2017, all pediatric tympanoplasty type 1 was performed using only fascia temporalis; and an unpublished study had shown anatomical success, with this technique, 60%.
In 2017, we started tympanoplasty combining temporal fascia and cartilage.
The purpose of this study is to evaluate our anatomic and functional results with this newly adopted technique.

Correspondence:
Sy A.
Department of Otorhinolaryngology and Head and Neck Surgery
Children's Hospital of Diamniadio, Senegal
Email: abdousy201@gmail.com
Phone: +221776458612

PATIENTS AND METHOD

The study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Children's Hospital of Diamniadio (SENEGAL), between January 2017 and December 2020. We retrospectively analyzed the medical records of 37 patients who underwent type 1 tympanoplasty with the combined use of fascia temporalis and cartilage at our clinic.
Inclusion criteria include patients of either sex in the age group of 7-15 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.

Auditory function was analyzed by performing preoperative and postoperative pure tone audiometry. The audiometric evaluation was carried out in a soundproof room with a diagnostic audiometer. Pure tone thresholds were obtained using earphones, and the average of the three frequencies tested (0.5, 1, and 2 kHz) was used to calculate the mean air conduction, mean bone conduction, and mean air-bone gap.

All patients underwent tympanoplasty type I by the same team under general anesthesia with a retroauricular approach after excising the margins of the perforation. Temporalis fascia graft was harvested by retroauricular approach. A self-retaining mastoid retractor is placed in the upper part of the incision, and further retraction of the uppermost part of the incision is done by a double hook retractor. Blunt dissection was carried out until the temporalis fascia was reached. The fascia of adequate size was removed using scissors. The cartilage was harvested from the concha. It was used as the graft material
without thinning. Grafts were placed by underlay technique: the fascia temporalis (FT) was first placed, and then it was lifted with the tympano-meatal flap. The cartilage was placed under FT to reinforce it and was pushed forward to the anterior angle. Gelfoam was packed in the middle ear space to support the graft. The external ear canal was packed with a medicated (Polydexa) aural wick. The wound was closed in 2 layers, and a mastoid dressing was done. All patients were given a course of broad-spectrum antibiotics, analgesics, and decongestants for 10 days.

All of the patients were followed up for at least one year following surgery. The tympanic membrane was first assessed 2 months after surgery.

The hearing assessment was done at 2 and 6 months postoperatively. The evaluation of functional outcome was based on the postoperative air-bone gap (which was calculated from the mean postoperative air conduction threshold and the mean preoperative bone conduction threshold, to avoid a false reduction of the air-bone gap in cases of postoperative perceptive hearing loss).

Anatomical success was defined as an intact graft without perforation, retraction, or lateralization, and a dry ear, 6 months after surgery.

The functional definition of a successful graft was an air-bone gap (ABG) ≤20 dB.

RESULTS

Epidemiological data
The series consisted of 19 girls and 18 boys with a mean age of 14 years [7-15 years].

Clinical data
Thirty-two patients (86.5%) had sequela tympanic perforation of chronic progressive otitis.
Five patients (13.5%) had post-traumatic perforation without spontaneous healing.
Seven procedures (19%) were revision myringoplasty previously performed with fascia temporalis alone.

Preoperative audiometry
The mean pre-operative air-bone gap (ABG) was 24 decibels (dB) with extremes of 14 and 40 dB. Twenty-five patients (67.5%) had a mean pre-operative ABG between 21 and 30 dB. (Table I)
Intraoperative data
The ossicular chain was mobile in all cases.

Postoperative complications
We noted 5 cases (13.5%) of postoperative complications: chondritis in 1 case, myringitis in 3 cases, and 1 case of labyrinthization.

Anatomical results
At 6 months postoperatively, we noted a graft integration rate of 89%. There were 11% anatomical failures consisting of a residual anterior perforation.

Functional results

The main gain in ABG was 12 decibels, with the main post-operative ABG reducing from 24 to 12 decibels. Thirty-one patients (84%) had postoperative ABG ≤ 20 decibels. (Table I)

Table I: Comparison between pre- and 6 months post-operative air-bone gaps

Air-bone gap (decibels)	Pre-op (N, %)	Post-operative (N, %)
0 – 10	0	10
11 -20	6	21
21 –30	25	5
31 –40	6	1
Total	37	37
Mean ABG	24 dB [13 - 40]	12 dB [5 - 35]

DISCUSSION

In our clinical practice, we encounter a great deal of patients suffering from chronic suppurative otitis media, leading to tympanic membrane perforations, retractions, and atelectasis. More perforations are subtotal, and more middle ears are inflamed and granular.

Since the advent of the modern tympanoplasty by Wullstein and Wollner, clinicians have sought the ideal graft material for the closure of the tympanic membrane perforations. Graft materials have historically been judged based on their durability and postoperative hearing results. In adults and children, the traditional graft material has been temporalis fascia, with success rates ranging from 60% to 99% in adults and 35% to 94% in children.[6] In the pediatric population, dysfunction of the Eustachian tube may diminish middle ear ventilation and reduce initial closure or result in subsequent reperforation.[6] Moreover, chronic upper respiratory tract infection, shorter Eustachian tube, difficulties in postoperative care in children and glued ears in the other ear may militate against success.

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.[7]

Temporalis fascia is the commonly used graft material for tympanic membrane reconstruction, because it is an autograft with an excellent chance of take up, available close to the site of operation making its harvesting easier, a low basal metabolic rate, increased success rate, and its thickness is more or less similar to that of a tympanic membrane.[8] Temporalis fascia usually provides good closure, at least in the short term.[6] Unfortunately, recurrent perforation is common in the long term,[9] as well as retraction and graft medialization in cases of eustachian tube dysfunction [8], a frequent condition in children. Long-term graft stability is important in economically deprived areas, where recurrent upper respiratory infections may be common.[10]

For pediatric myringoplasty, it has been suggested that a more robust graft material, such as cartilage, may lead to a more durable repair with hearing results equivalent to FT.[11] The cartilage was first used to rebuild the ossicular chain in 1958 by Jansen.[12] Some years later, this material began to be used as a graft in tympanoplasty, especially in cases of advanced middle ear diseases, because of their robustness, offering greater resistance to resorptions. The mechanical characteristics of cartilage offer the advantage of high resistance to retraction and reperforation. Cartilage has a constant shape, firmer than fascia, and also lacks fibrous tissue, so the post-operative dimensions remain the same it is also nourished by diffusion and shows great adaptation with the tympanic membrane.[13] Cartilage is well tolerated by the middle ear,[14] easy to manipulate and place in the middle ear, and has less shrinkage and displacement rate. Moreover, since it is nourished largely by diffusion, the cartilage becomes well incorporated in the tympanic membrane.[13, 15] The thickness of cartilage creates stiffness that is more resistant than the fascia to the anatomic deformities caused by negative middle ear pressure, thus improving the long-term integrity of the graft.[16] In addition, cartilage provides support to an accurately placed temporalis fascia graft.

Potential drawbacks of cartilage graft are:

1. The graft opacity, as it may be more difficult to detect eventual residual/recurrent cholesteatoma;
2. The investigation of the middle ear status by tympanometry is not useful after cartilage tympanoplasty due to the effects of stiffness on tympanic membrane compliance;[17]
3. Ventilation tube insertion may also be difficult after cartilage tympanoplasty.[17]

We prefer conchal cartilage because it is readily available via the retroarticular approach, is usually thick, and can be sliced, with a limited tendency to curl.

In Patel's study, the graft uptake up rate for the temporalis fascia graft was 90%, and for the cartilage island graft was 97.5%.[18] In our study, graft integration was 89%. All the studies show a higher graft take-up rate when cartilage is used. This could be due to the ability of the cartilage to resist resorption.[18]

There has been some speculation about the hearing results of the cartilage tympanoplasty. 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.[5] Air-bone gap (ABG) reduction after cartilage tympanoplasty type 1 varies in the literature between 7.6 dB and 12.6dB.[5] In our study, the mean audiological improvement was 12 dB comparable to Al Khtoum (11.4 dB) and Castro (12.5 dB).[19, 20] Concerns that the stiffness and mass of cartilage grafts may adversely affect hearing have not been reported in clinical outcome studies.[21]

CONCLUSION

In our clinical practice, the combined use of cartilage and fascia temporalis (FT) provides good anatomical and functional results in pediatric type 1 tympanoplasty. These results need to be confirmed by prospective studies comparing this surgical procedure with that using FT alone in type 1 tympanoplasty.

REFERENCES

1. Wullstein H. Functional operations in the middle ear with a split-thickness skin graft. Arch Otorhinolaryngol 1952; 161:422–435.
2. Zollner F. The principles of plastic surgery of the sound-conducting apparatus. J Laryngol Otol 1955; 69:637–652.
3. Anderson J, Caye-Thomasen P, Tos MA. Comparison of cartilage palisades and fascia in tympanoplasty after surgery for sinus or tensa retraction cholesteatoma in children. Otol Neurotol 2004; 25:856–63.
4. Iacovou E, Vlastarakos PV, Papacharalampous G, Kyrodimos E, Nikolopoulos TP. Is cartilage better than temporalis muscle fascia in type I tympanoplasty? Implications for current surgical practice. Eur Arch Otorhinolaryngol 2013; 270:2803–2813.
5. Prasad S, Agrawal A, Ahlawat B, Kumar A, Naik SM, Nagvanshi A. Pediatric Tympanoplasty Type I (Cartilage Vs Temporalis Fascia Graft). IOSR Journal of Dental and Medical Sciences 2016;15(2):61-65.
6. Sarkar S, Roychoudhury A, Roychaudhuri BK. Tympanoplasty in children. Eur Arch Otorhinolaryngol 2009; 266:627–633.
7. Tos M. Manual of middle ear surgery. Approaches, myringoplasty, ossiculoplasty, and tympanoplasty. Michael E.Glassocok 3rd -1993;1:7-10.
8. Sunil S Nichlani, Mohan V Jagade, Arunprabhu Ganeshan. Reconstruction of the Tympanic Membrane with Partial Tragal cartilage Graft Versus Temporalis Fascia Graft. Bombay Hospital Journal 2010;52(2):197-201.
9. Nardone M, Sommerville R, Bowman J, Danesi G. Myringoplasty in simple chronic otitis media: critical analysis of long-term results in a 1,000-adult patient series. Otol Neurotol 2012; 33:48–53.
10. Smith MCF, Huins C, Bhutta M. Surgical treatment of chronic ear disease in remote or resource-constrained environments. J Laryngol Otol 2019; 133:49–58.
11. Nicholas BD, O'Reilly RC. Is Cartilage Preferable to Fascia Myringoplasty in Children? Laryngoscope 2010; 120:2136-37.
12. Jansen C. Cartilage tympanoplasty. Laryngoscope 1963; 73:1288-1302.
13. Levinson RM. Cartilage-Perichondrial Composite Graft Tympanoplasty in the Treatment of Posterior Marginal and Attic Retraction Pockets. Laryngoscope 1997; 97:1069-1074.
14. Tos M. Cartilage Tympanoplasty: classifications of methods, techniques, results: Edition I, Thieme,2009.
15. Kerr AG, Byrne JE, Smyth GD. Cartilage homografts in the middle ear: a long-term histological study. J Laryngol Otol.1973; 87:1193-1199.
16. Chouhan A, Singh BK, Verma PC. Role of cartilage as a graft material for tympanic membrane and in middle ear reconstruction. International Journal of Otolaryngology and Head & Neck Surgery 2015; 4:66-72.
17. Ozbek C, Onur C, Tuna EU. A comparison of cartilage palisades and fascia in Type1 tympanoplasty in children: Anatomic and functional results. Otol Neurotol 2008; 29: 679-83.
18. Patel K, Gugliani A, Mehta D, Vishwakarma R. Effects of Temporalis fascia and Cartilage Island graft in type 1 tympanoplasty. BJKines-NJBAS 2019;11(1):8-13.
19. Al-Khtoum N, Hian MA. Myringoplasty in children: retrospective analysis of 35 cases. Braz J Otorhinolaryngol. 2009; 75:371-374.
20. Castro O, Perez-Carro AM et al. Myringoplasties in children: our results. Acta otorhinolaryngol Esp. 2013; 64:87-91.
21. Vaidya S, Sharma H. Cartilage tympanoplasty for management of TM perforation: review of the literature. World Articles of Ear, Nose, and Throat (WAENT) 2012;5(1):1-11.