

EARLY INTERVENTION OF PARS TENSA RETRACTION POCKETS IN CHILDREN BY CARTILAGE REINFORCED TYMPANOPLASTY

KC T^{*}, Shrestha S^{*}, Kafle P K^{*}

ABSTRACT

Posterosuperior retraction pockets involving pars tensa of a tympanic membrane is not an uncommon problem particularly in pediatric population. This occurs as a sequelae of chronic otitis media with effusion. The management options include “wait and watch,” medical treatment and surgery. But in patients in whom retraction is severe and seems to be irreversible the treatment should be surgery at the earliest. We performed cartilage reinforced tympanoplasty in 29 ears of 28 children who had grade III and IV posterosuperior retraction pockets of the pars tensa. Their average pre-operative hearing loss was 16.6 and 19.4dB for grade III and IV retraction pockets respectively with 10 and 12.4dB post operative gain. No recurrences were noted except few minor complications. We suggest that such procedures are safe and should be performed at the earliest rather than to keep under surveillance and medical treatment only.

Key Words: *Pars tensa retraction pockets, Tympanic membrane atelectasis, atelectatic ear, Tympanoplasty.*

INTRODUCTION

Atelectatic retraction pocket results from a gradual thinning and medialization of the tympanic membrane. They commonly occur in pars flaccida region or in the posterosuperior quadrant of the pars tensa, because these are the most flaccid region of the tympanic membrane.¹ Retraction of the tympanic membrane is believed to occur due to combination of several pathological processes.^{2,3} Dysfunction of the Eustachian tube predisposes to otitis media with effusion. The gas diffusion mechanism in the middle ear cavity is impaired resulting in sustenance of the negative middle ear pressure. Finally, the inflammatory process, over a period of time, results in destruction of the collagen fibers in the lamina propria and weakening of the tympanic membrane with consequent retraction.^{4,5} The immediate and long term effects of defective aeration of the middle ear cleft and the retraction are

significant, and the loss of compliance of the tympanic membrane may result in impairment of the conduction mechanism. This is further exacerbated when the retraction segment drapes over the incudostapedial joint leading to resorption of long process of the incus. The migratory potential of the outer squamous epithelial layer of the tympanic membrane can be affected resulting in accumulation of debris and infection. The retraction pocket if infected deteriorates in 15-20% of cases^{6,7} and in minority of cases the retraction pocket progresses to cholesteatoma formation.^{4,8}

The management of atelectatic ear is one of the most controversial issues facing the otolaryngologists. The controversy is augmented by the fact that early in the course of the disease, and even in the presence of incus erosion, hearing loss is frequently minimal, and patients for the most part are asymptomatic.⁹ The “gold standard” preventive

*Kathmandu Medical College Teaching Hospital, Sinamangal, Kathmandu, Nepal.

Address for correspondence : Dr. Toran KC
Kathmandu Medical College Teaching Hospital, Sinamangal, Kathmandu, Nepal.
Email: torankc@yahoo.com

treatment, to avoid the development of the tympanic retraction in the presence of otitis media with effusion is ventilation tube insertion.¹⁰ However in many cases, this treatment is not efficient,¹¹ so that retraction pocket remains a frequent and challenging pathologic condition in pediatric otology. The aim of the current study was to assess the efficiency of tympanic reinforcement with cartilage grafts in a treatment of severe retraction pocket of the posterosuperior quadrant of pars tensa in children. The result suggests that this technique is safe and efficient both anatomically and functionally.

MATERIALS AND METHODS

All the children who presented with retraction of the pars tensa and one or more of the following symptoms-impaired hearing, recurrent ear ache and ear infection were included in the study. There were 28 children among whom 29 ears were operated during four years period till July 2004. The patients with discharging deep pockets and cholesteatoma were deemed unfit for this type of procedure and were excluded from the study. Only one child had undergone similar type of tympanoplasty for both ears. Those who underwent ventilation tube insertion or mastoid explorations for another ear has been excluded from the study. Twelve patients who lost in the follow up were also excluded.

The age of the children ranged from 5 to 15 years and the average age is 6 years. Some of the children had associated malformations or diseases that could account for the dysfunction of the Eustachian tube and subsequent development of the tympanic retraction: two cases of repaired velopalatine clefts and one case of adenotonsillectomy.

Mainly Sade's classification of pars tensa retraction pockets was used with some modifications.^{12,13} Grade I retraction involves a mild retraction of the tympanic membrane. A grade II retraction describes tympanic membrane retraction to the incus or stapes, the so called myringo-stapediopexy. The grade III retraction is an extension of type II retraction but with involvement down to the promontory. A grade IV retraction is a continuation of type III, but full extent or depth of the retraction can not be adequately visualized by otoscopy. If significant keratin debris accumulation is observed in a pars tensa retraction, it is considered a mesotympanic cholesteatoma as opposed to a grade IV retraction.

Surgical procedure

A detailed preoperative history was taken including symptoms, predisposing factors and previous medical and surgical treatments. Otological examination was carried out and following were recorded; site and severity of retraction pockets, status of the ossicular chain and any other middle ear abnormalities. In all cases pure tone audiometric (PTA) or free field test including impedance test were done. All the surgical procedures were carried out through an end aural approach under general anesthesia. A mastoid retractor was fixed in between the incisions and the tympanic membrane was examined carefully to confirm the extent of the retraction. To identify the depth of the fundus of the pockets, normal saline was instilled and gradually sucked with 20G micro-suction tip while observing through the microscope. In this way deep fundus are better seen as the line of refraction passes away from the normal while passing through rarer (air) to denser medium (Normal saline). After transmeatal flap elevation, the retracted segment of the pars tensa was gently lifted off. The ossicular status is then checked. If it is intact then incudostapedial joint was temporarily disarticulated with the help of 2 mm circular knife to prevent vestibular injury. For deeper retractions posterosuperior bony canal lateral to the annulus was drilled away. This helps to clear away remaining portion of the retracted tympanic membrane in the posterior mesotympanum and to clear the adhesions from these areas. The redundant portion of the tympanic membrane was excised. A piece of tragal cartilage was excised and perichondrium was peeled off. An appropriate size of sculptured cartilage was placed in the posterior mesotympanum behind the oval window, encroached between its medial wall and bony wall of the canal. Ossicular discontinuity was fixed with sculptured cartilage. There were four ears in which long process of incus were absent. In two of them body of the autologous incus was interposed between the handle of malleus and supra structure of stapes while in two sculptured tragal cartilage was interposed and fixed with stapes head with cyanoacrylate® tissue adhesive. In 2 ears ventilation tube was inserted along with the cartilage tympanoplasties. Both of them

Fig. 1

Fig. 1 : Atelectatic retraction of the pars tensa of the tympanic membrane.

had retraction pockets with refractory middle ear fluid. Most of the patients were discharged on 3rd post operative day. Pack and stitches were removed on 10th post operative day. Subsequent follow up was between 6 weeks and 10 weeks, since all the patients did not attend during the specified period of time.

RESULTS

Of the 28 children 29 ears were operated. There were 17 boys and 11 girls. Their age ranged from 5 years to 15 years with a mean of 6 years.

Of them, grade IV and III retraction pockets were present in 15 and 14 ears respectively. Contra lateral middle ear disease was observed in 18 children. Those ears had various grades of posterosuperior retraction pockets and two had chronic suppurative otitis media (CSOM) of tubotympanic and a single case had CSOM of attico-antral type.

Regarding the status of the ossicular chain, lenticular process was destroyed in 11 ears while long process of incus in 4 ears. The average hearing loss for grade III and grade IV retractions were 16.6 and 19.4 dB air bone gap (dB ABG) respectively, table I. In all the operated ears the graph of impedance audiometry was of B type.

The average hearing gain for grade III and grade IV retractions were 10 and 12.4 dB respectively and were assessed between 6th and 10th post operative week. Though our follow up time ranged from 6 weeks to 4 years all patients were not regular enough to attend the OPD for regular evaluation. Of the 28 children only 18 were brought to follow up till 6th month post operatively regularly. Twelve children were never brought to OPD after stitch and pack removal and were excluded from the study.

The hearing gain was 10 and 12.4 dB for grade III and IV

retractions respectively. Though our follow up time was short none of the patient had recurrence. But minor complications like sudden conductive type of hearing loss, probably due to slippage of the interposed cartilage between the ossicles was identified in a single ear. While another case had residual perforation due to grommet extrusion at 6th month follow-up. Cartilage extrusion was seen in a single ear at 3rd month. While in two ears there were no hearing changes. A successful outcome was defined as an intact tympanic membrane without recurrence of retraction.

DISCUSSION

Initially described in 1963 by Jansen¹⁴ the use of cartilage grafts in the tympanoplasty has been proposed by numerous authors for the tympanic walls or tympanic membrane or to restore continuity of the ossicular chain.^{15,16} However, until now, most studies concerned heterogeneous populations comparing adults as well as children.

The incidence of pars tensa retraction is quite common among children and many of them goes unnoticed for years until the ears starts discharging. Tos *et al.*,¹⁷ studied a cohort of 327 children born in 1975 and followed them periodically for 16 years. The incidence of atrophy of the tympanic membrane was found to be 2.7% at age of 5 years, 5.1% at age of 7 years, 2% at age of 9 years, 8.1% at age of 10 years, 3.6% at age of 12 years, and 5.7% at age of 16 years. They found the incidence of myringostapediopexy to be 0.5% at age of 5 years, 2.5% at age of 7 years, and 4.2% at age of 16 years. Forty percent of the myringoincudopexies were stable, 36% fluctuated and 26% disappeared.

In a study of temporal bones, Ruah *et al.*,¹⁸ compared the histopathology of normal ears, ears with Otitis media with effusion (OME), and ears with purulent otitis media (POM). They found persistence of primitive mesenchyme tissue in the pars flaccida and in the posterior superior quadrant in the ears

Table I : Grades of retraction in relation to the ossicular status and hearing loss

Retraction Grading	Ossicular status		Hearing loss (dB ABG)	Hearing loss (in average)
Grade III	Lenticular process necrosis (One ear also had OME with 26 dB loss)	4 ears.	19	16.6 dB
	Long process necrosis	1 ears.	18	
	Intact ossicles	9 ears.	13	
Grade IV	Lenticular process necrosis	7 ears.	21.14	19.4 dB
	Long process necrosis (One ear also had OME with 40 dB loss)	3 ears.	24.6	
	Intact	5 ears.	12.4	

of the patients up to 2 months of age in normal specimens, up to 4 months of age in ears with OME, and up to 10 months of age in ears with POM. They theorized that the delay in resorption and differentiation of mesenchyme may be responsible for the inability of the elastin fibres in the tympanic membrane to mature. The authors concluded that the delay in the maturation could be a risk factor for the development of retraction pockets, once the mesenchymal tissue disappears. It seems that inflammation leads to the persistence of mesenchyme in the middle ear, which in turn delays or disrupts development of normal elastic fibers in the tympanic membrane. Macbeth¹⁹ also concludes that posterior aspect of pars tensa is more prone to retraction than other parts of pars tensa. Even more, anteriorly, the mucosa of the middle ear is dominated by pseudostratified ciliated columnar epithelium, and posterior middle ear is covered by flat cells.²⁰ The anterior mucosa is covered by a thick epithelial lining covered with mucus, where as posteriorly the lack of cilia on the flat cells may lead to stagnation of inflammatory exudates. It has been shown that middle ear effusions have high concentration of proteinases, especially collagenases.²¹ The prolonged approximations of these enzymes with that of the tympanic membrane may cause the destruction in the collagenous layer of the tympanic membrane and results in weakening in that part of the tympanic membrane²² and subsequent posterosuperior retraction pockets.

Various authors have tried to grade the severity of retraction of tympanic membrane.^{6,7} However it should be considered as a dynamic condition as there may be change in grading in time, some pockets may remain stable and unchanged and others may resolve spontaneously or deteriorate and progresses to cholesteatoma formation, whilst cholesteatoma occurs in a small percentage of patients with the severity of the retraction.^{5,23} Sade reported that deterioration was more common with grade III and IV retraction pockets.²⁴ At our institution we follow the same principles to operate grade III and IV retraction pockets of pars tensa. The various management options for the retraction pockets are as follows.²⁵

1. Wait and watch
2. Medical treatment
3. Ventilation tube insertion (VTI)
4. Excision of the retraction pockets + VTI
5. Tympanoplasty procedure with reinforcement of the tympanic membrane.
6. Mastoid venting.

The percentage of wide variety of the treatment modalities in use refers to the fact that no single treatment modality is superior to another. Medical treatment comprises nasal or systemic decongestant and forced inflation of the middle ear

(Valsalva maneuver). This may revert some of the early retractions. Ventilation tube insertion is the commonest surgical procedure performed. However, the recurrence rate of retraction is very high after extrusion of the ventilation tube and this is attributed to persistent Eustachian tube dysfunction or adherence of the tympanic membrane to the underlying structures.^{24,26} We do not insert ventilation tubes for grade III and IV retraction pockets where there is always myringo-incudostapediopexy and for us indications for ventilation tube inserting is for grade II retraction with or without OME with consideration of hearing status of the ear.

For severe retractions, tympanoplasty procedures using composite grafts of cartilage and perichondrium have been suggested by several authors.^{27,28,29} Though the composite grafting provides rigorous reinforcement it may impede ossicular movement and may also hinder visualization of developing cholesteatoma behind the intact drum.³⁰ In all our cases we used autologous tragal cartilage after peeling off the perichondrium and we did not use the composite graft to reconstruct the tympanic membrane.

Besides the technique of tympanic reinforcement, other factors may influence the risk of retraction recurrences; particularly this is true in children. This may be caused by the decreased or altered function of the Eustachian tube.³¹ Though our average follow up time is 7 months, we did not observe recurrences of retractions. Long term success rate in terms of recurrences is between 20-33% according to various authors.^{27,32}

In the present series average hearing gain for type IV retraction pockets mostly with ossicular reconstruction was 12.4 dB and 10 dB for grade III pockets. These improvements were more at low frequencies. In several such series cartilage reinforced tympanoplasties also has improved hearing even when performed with or without ossicular reconstructions.^{30,31,33}

CONCLUSIONS

The use of cartilage grafts to reinforce the tympanic membrane is a safe technique that efficiently prevents recurrences of severe retraction pockets of the pars tensa and enables hearing improvement whatsoever the status of the ossicular chain.

Particularly in the Nepalese context, where a child with severe retraction pockets can not come for regular follow-up such surgery should be advised at the earliest by every otolaryngologists to prevent cholesteatoma formation and there impending complications.

REFERENCES

1. Khanna SM, Tonndorf J. Tympanic membrane vibration in cats studied by time-averaged holography. *J. Acoustic Soc Am* 1972; 51: 1904-1920.
2. ARS B. Tympanic membrane retraction pockets. *Acta Otolaryngol. Belg.* 1995; 49: 163-171.
3. Helms J. Retraction pockets/atelectatic middle ear. *Int. J. Ped. Otolaryngol.* 1995; 32(suppl): 159-161.
4. Wells M.D., Michaels L. Role of retraction pockets in cholesteatoma formation. *Clin. Otolaryngol.* 1983; 8:39-40.
5. Yoon T.H., Schachern PA., Paparella MM. et al., Pathology and pathogenesis of tympanic membrane retraction. *Am. J. Otolaryngol.* 1990; 11: 10-17.
6. Sade J, Avraham SK, Berco E. Atelectasis, retraction pockets and cholesteatoma. *Acta Otolaryngol.* 1981; 92: 501-512.
7. Charachon R, Barthez M, Lejune JM. Spontaneous retraction pockets in chronic otitis media: medical and surgical therapy. *Ear Nose Throat J* . 1992; 71: 578-583.
8. Akyildiz N, Akbay C, Ozgirgin ON et al., The role of retraction pockets in cholesteatoma development: an ultrastructural study. *Ear Nose Throat J* . 1993; 72: 210-212.
9. Elder LM, Grundfast KM. The atelectatic ear. In: Lalwani AK, Grundfast KM, eds. *Pediatric Otolaryngology and Neurotology*. Philadelphia: Lippincott- Raven Publishers, 1988; 645-62.
10. Forsen JW. Chronic disorders of the middle ear and mastoid. In: Welmore RF, Muntz HR, McGill TJ et al., eds. *Pediatric otolaryngology: principle and practice pathways*. New York, Stuttgart: Thieme, 2000: 281-304.
11. Roland NJ, Phillips DE, Rogers JH, Singh SD. The use of ventilation tubes and the incidence of cholesteatoma surgery in the pediatric population of Liverpool. *Clin Otolaryngol.* 1992; 17:437-444.
12. Sade J. Atelectatic tympanic membrane: histological study. *Ann Otol Rhinol Laryngol.* 1993; 102: 712-716.
13. Dornhoffer John L. Surgical management of the atelectatic ear. *Am J Otol.* 2000; 21(3): 315-321.
14. Jansen C. Cartilage tympanoplasty. *Laryngoscope.* 1963; 73: 1288-1302.
15. Heerman J, Heerman H, Kopstein E. Fascia and cartilage palisade tympanoplasty. *Arch Otolaryngol.* 1970; 91: 218-241.
16. Kerr AG, Byrne JE, Smyth GD. Cartilage homograft in the middle ear: a long term histological study. *J Laryngol Otol.* 1973; 87: 1993-1999.
17. Tos M, Stangerup SE, Larsen P. Incidence and progression of myringo-incudopexy after secretory otitis media. *Acta Otolaryngol.* 1992; 112: 512-517.
18. Ruah C, Schachern PA, Paparella MM et al., Mechanism of retraction pocket formation in the pediatric tympanic membrane. *Arch Otolaryngol Head and Neck Surg.* 1992; 118:1298-1305.
19. Macbeth R. Some thoughts on the Eustachian tube. *Proc R Soc Med* 1959; 52: 151-161.
20. Sade J. Middle ear mucosa. *Arch Otolaryngol.* 1966; 84: 137-143.
21. Granstrom G, Holmquist J, Jaristedt J et al., Collagenase activity in the middle ear effusions. *Acta Otolaryngol.* 1985; 100: 405-413.
22. Jhomson ISD. Exudative otitis media, grommets and cholesteatoma. *J Laryngol Otol.* 1974; 88: 947-953.
23. Wolfman DE, Chle RA. Experimental retraction pocket cholesteatoma. *Ann. Otol Rhinol Laryngol.* 1986; 95: 639-644.
24. Sade J. Treatment of cholesteatoma and retraction pockets. *Eur Arch Otolaryngol.* 1993; 250: 193-199.
25. Srinivasan V, Banhegyi G, O'Sullivan G, Sherman I.W. Pars tensa retraction pockets in children: treatment by excision and ventilation tube insertion. *Clin. Otolaryngol.* 2000; 25: 253-256.
26. Avraham S, Luntz M, Sade J. The influence of the ventilating tubes in the surgical treatment of atelectatic ears. *Eur Arch Otolaryngol.* 1991; 248: 259-261.
27. Levinson RM. Cartilage perichondrium composite graft tympanoplasty in the treatment of posterior marginal and attic retraction pockets. *Laryngoscope.* 1987; 97: 1069-1074.
28. Mills RP. Management of the retraction pockets of the pars tensa. *J Laryngol Otol.* 1991; 105: 525-528.
29. Yung MW. Retraction of the pars tensa – long term results of surgical treatment. *Clin Otolaryngol.* 1997; 22: 323-326.
30. Dornhoffer, John L. Hearing results with cartilage tympanoplasty. 1997; 107(8): 1094-1099.
31. Vincent Couloigner, N. mMolony, P Viala et al., Cartilage tympanoplasty for posterosuperior retraction pockets of the pars tensa in children. *Otology and Neurotology.* 2003; 24: 264-269.
32. Blaney SPA, Oyarzabai M, Tierney P et al., The surgical management of atelectatic tympanic membrane in children: 6 years of simple excision and ventilation tube insertion. *J Laryngol Otol.* 1999; 113(suppl): 34-35.
33. Dornhoffer, John L. Surgical management of atelectatic ear. *Am J Otol.* 2000; 21(3): 315-321.

