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Review Article

Overlay and underlay tympanoplasty revisited: a review

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ABSTRACT

Myringoplasty conventionally is the reconstitution of the perforated tympanic membrane with placement of the graft either on the external or internal side of the residual eardrum The first recorded attempt to close tympanic membrane perforation was by Banzer in 1640; with a pig's bladder membrane stretched over an ivory tube. Paper patching, perforation margin cauterization, the overlay or underlay, skin, fascia, perichondrium, cartilage or dural grafting were the developments in the repair of the ear drum. The temporalis fascia is superior to other grafts as it has a better uptake because of a low basal metabolic rate and, minimal shrinkage due to its low elasticity. Lateralization or medialization are the likely issues respectively of either technique. The technique and its development historically have been elaborated upon.

Keywords: Myringoplasty, Overlay, Underlay, Medialization, Lateralization

INTRODUCTION

Myringoplasty utilizing the temporalis fascia has stood the test of time, with a successful outcome, subject to proper case selection, appropriate tissue harvest, it's thickness, placement, sterilization and post operative middle ear pressure equalization. The temporalis fascia has been found to be superior to other grafting material vis a vis, superior uptake of graft due to its relatively low basal metabolic rate, less likelihood of shrinkage due to low elasticity, with a texture similar to that of the original or contralateral tympanic membrane and easily accessible at the surgical field in its proximity. The techniques of overlay, underlay and at present the interlay are categorized in accordance to the placement of the graft with respect to to the residual drum.

REVIEW OF LITERATURE

History of treating ear disease and performing mastoid surgery can be traced six centuries back to Galen of Pergenion (130-200 AD) but no evidence of treating a tympanic membrane perforation can be traced.[1]

Hippocrates 460-377 B. C. described the existence of tympanic membrane as a 'dry spun web', which is a part of the organ of hearing.[2]

Fallopius 1523-1563 is credited for introducing the term tympanum.[3] Volcher Coiter of Gromngen, Holland in his paper "De Aditus Instrumento' (1592) suggested that the tympanic membrane protected the middle ear and preserved the purity of the air contained in it.[4]

The first recorded attempt to close tympanic membrane perforation was by Banzer in 1640; with a pig's bladder membrane stretched over an ivory tube.[5]

Yersley 1841 applied a simple ball of moist cotton against the perforation.[6]

In 1883, Toynbee devised artificial membrane tympani, a thin rubber disc with a silver wire stem to assist in its placement.[7]

Blake used the paper patch method to seal the tympanic membrane defect which is widely used even now.[8]

Rossa in 1876 was the first to attempt closure of the tympanic membrane perforation by destroying its margins by cautery with silver nitrate beads.[9] Okuneff in 1895 introduced trichloroacetic acid the cauterizing agent in use today.[10]

In 1919, Joynt observed that a patch on the perforation after cautery gave better results Pohlman in 1951 introduced 'Korogel insert' a tube closed at one end and made of flexible plastic material of different sizes and shapes to fit the individual ear.[11,12]

The underlay technique for myringoplasty was promoted by Hough in 1970 who proved it to be a superior method because of the following reasons:-secondary separation of the graft from the handle of malleus is practically nil, there are no chances of burying the external auditory canal epithelium, thereby excluding cholesteatoma formation ,ossicular chain and round window reflexes are easily observed as adequate exposure of the middle ear is possible, moreover the contour and structure of external auditory canal is well preserved with this technique.[13]

Glasscock et al in 1982 dealing with the post- auricular undersurface tympanic membrane grafting, presented a huge series of 1556 cases of grafted ears with temporal fascia by undersurface technique. He reported a 92.8% success rate on long term and 94.8% success rate on short term follow-up. They preferred the loose areolar tissue overlying the true temporal fascia as it became a thin parchment like material that could be easily manipulated when rehydrated, the temporalis muscle is not violated, therefore there is virtually no bleeding from the graft site, the graft does not require thinning or muscle removal in preparation and finally in case of failure of the initial graft, the true fascia is still available.[14]

Zanam et al presented 200 cases of overlay myingoplasty with temporal fascia using three meatal flaps and claimed 98% success with minimal anterior blunting and lateralization of graft.[15]

Bluestone et al achieved higher take rate by keeping the graft lateral to the tympanic membrane. They related failure of medially placed grafts to the fluctuating negative middle ear pressure that tends to pull the graft away from the residual tympanic membrane.[16]

Sheehy et al observed that for smaller perforations, a medial graft may be satisfactory but, for larger perforations, the laterally placed fascia graft has a comparatively better outcome and does not lead to postoperative blunting in the anterior sulcus or lateral healing of the graft.[17]

Sheehy et al reviewed 472 subjects of type I tympanoplasty and found a statistically significant relationship between the size of perforation and degree of hearing impairment. They found over 97% success rate with post auricular approach. Blunting of the anterior sulcus and lateral healing of the graft were very uncommon and only 3% of the cases developed sensori-neural hearing loss.[17]

Sheehy had a reduced successful uptake in large and anterior perforations. It was attributed to the medial underlay technique.[17] Ophir et al, Smyth and Koch et al even reported similar outcome.[18-20]

Koumne et al analysed 69 tympanic perforations of underlay tympanoplasty. The average postoperative period for complete re-epithelialization was about 16 days. No blunting of the anterior tympanomeatal angle or lateralization was observed. Short term outcome in terms of successful graft uptake was 94.2%.[21]

Stage carried out underlay tympanoplasty with the graft lateral to the malleus handle, in 39 ears with predominantly large or anterior pars tensa perforations. After a median observation time of 20 months, only one ear was found to have a small re-perforation. All ears had normal tympanomeatal angle but 12 ears showed a small degree of lateral fixation of the graft from the malleus handle.

It was concluded that this technique is a good alternative to conventional underlay myringoplasty in ears with perforations involving the area anterior to the handle of malleus.[22]

Aoyagi et al studied the effects of ageing on the preoperative and postoperative hearing results in 642 patients undergoing tympanoplasty. The average air and bone thresholds in patients were appreciably poorer in younger patients and increased with age. Labyrinthine function thus appears to be gradually aggravated with age in patients with chronic inflammatory ear disease. Thus, they recommend that tympanoplasty should be carried out at an early age.[23]

Similar anterior hitch method of tympanic membrane repair was used by Scally and Ker 1966 and they achieved better results in terms of the perforation closure.[24]

RESULTS ACHIEVED BY VARIOUS AUTHORS

Strauss et al performed both overlay and underlay myringoplasty operations. The percentage of graft uptake and re-perforations did not significantly differ.[25]

Sheehy et al performed 472 myringoplasties with overlay technique during the 11 year period. The tympanic membrane perforation closure was successful in 97% of the cases. Blunting in the anterior sulcus and lateral healing of the graft were very uncommon.[26]

Garcia et al performed 460 myringoplasties 80% of the perforations closed successfully. Results were statistically better with the Onlay technique than with the underlay technique particularly in large operations.[27]

Sakai et al utilized the overlay method in 11 patients of which 81.8% had a successful closure in the initial surgery with only two re-perforations which closed in the second and third operation respectively. The advantage was minimal invasiveness as well as anesthesia and no requirement for packing the ear canal.[28]

Gibb et al performed underlay technique with temporal fascia graft uptake rate of 91.4% in dry ears and of 89.3% in the wet.[29]

FACTORS EFFECTING RESULTS

Vartianen et al found that preoperative factors (dry or wet ear), site of perforation or grafting techniques (underlay or overlay) did not affect the graft take rate.[30]

Livi et al on pathological basis used overlay or the underlay method and observed that in five years the material (Vein or fascia) if properly used with care showed similar results.[31]

Gimenez et al studied that pressure equalization mucociliary clearance of eustachian tube and degree of pneumatisation of the mastoid does not affect results of myringoplasty. The only significant correlation was mucociliary clearance time.[32]

Booth reported long term results three years after primary myringoplasty. The results were achieved with total perforations and not with partial posterior perforation. The anterior perforations were the most difficult to close.

Gersdorff et al documented that the overall closure rate after primary myringoplasties three years postoperative was 87.7% with improvement in hearing in 67.2% of cases. The best results were achieved with total perforation.[33]

Podoshin et al study showed that the success rate of the tympanoplasties was 90%. No difference was found in the rate of graft take regardless of whether fascia of the temporal muscle or tragal perichondrium was used.[34]

Berger et al concluded that results of revision myringoplasty were independent of patient age, location and size of perforation and the seniority of the surgeon.[35]

England et al proposed that cause of increased failure rates, particularly in anterior myringoplasties, is loss of underlay contact due to graft dehydration and shrinkage.[36]

CONCLUSION

Overlay and underlay techniques of myringoplasty are equivalent wrt uptake of graft and improvement in hearing, but in terms of complications underlay technique is better than the overlay. Underlay procedure is simple, easier to perform, with better assessment of ossicular chain integrity and mobility and it takes less time in comparison to the overlay. Thus the underlay technique of myringoplasty is quite popular. The overlay method is usually preferred in anterior quadrant perforations.

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REFERENCES

1. Hajar R. The air of history early medicine to Galen (Part I). Heart views. 2012;13(3):120-8.
2. Hippocrates (460-377 B.C.): The tympanic membrane hearing cited by Storrs L. Laryngoscope. 1996;76:185-95.
3. Imperatori CJ. Gabriello fallopius. Laryngoscope. 1948;58(5):431-47.
4. Adelmann HB. The "De Ovorum Gallinaceorum Generationis Primo Exordio" of Volcher Coiter (Part I). Ann Med History. 1933;5(4):327.
5. Najeeb T, Bangash WU, Siddiqui N. Temporal fascia versus tragal perichondrial graft in myringoplasty and tympanoplasty. Int J Otorhinolaryngol. 2019;5(1):15-9.
6. Yearsley J. Deafness practically illustrated. John Churchill Publisher. The British Library. 1863.
7. Mudry A. History of tympanoplasty. Otol Neurotol. 2005;26(3):554-5.
8. Golz A, Goldenberg D, Netzer A, Fradis M, Westerman ST, Westerman LM, et al. Paper patching for chronic tympanic membrane perforations. Otolaryngol Head Neck Surg. 2003;128(4):565-70.
9. Rossa DB. Diseases of the ear. 3rd edition, William Wood and Co., New York. 1876;334-40.
10. Goldman NC. Chemical closure of chronic tympanic membrane perforations. ANZ J Surg. 2007;77(10):850-1.
11. Jino ME, Kumar C, Kingsly DG. A study on chemical cauterization for small tympanic membrane perforation. Int J Surg. 2021;5(1):343-6.
12. Pohlman ME. IX The Artificial Ear Drum. Annal Otol Rhinol Laryngol. 1951;60(1):117-21.

13. Hough JV. Tympanoplasty with the interior fascial graft technique and ossicular reconstruction. Laryngoscope. 1970;80(9):1385-413.
14. Glasscock III ME, Jackson CG, Nissen AJ, Schwaber MK. Postauricular undersurface tympanic membrane grafting: A follow-up report. Laryngoscope. 1982;92(7):718-27.
15. Arshad M, Shahnaz A, Bashir M, Zaman A. Comparison of graft uptake in patients undergoing myringoplasty/tympanoplasty by overlay and underlay procedure. Professional Med J. 2019;26(11):1861-5.
16. Bluestone CD, Cantekin EI, Douglas GS. Eustachian tube function related to the results of tympanoplasty in children. Laryngoscope. 1979;89(3):450-8.
17. Sheehy JL, Anderson RG. Myringoplasty: a review of 472 cases. Ann Otol Rhinol Laryngol. 1980;89(4):331-4.
18. Ophir D, Porat M, Marshak G. Myringoplasty in the pediatric population. Arch Otolaryngol Head Neck Surg. 1987;113(12):1288-90.
19. Smyth GD. Surgical treatment of cholesteatoma: the role of staging in closed operations. Ann Otol Rhinol Laryngol. 1988;97(6):667-9.
20. Koch WM, Friedman EM, McGill TJ, Healy GB. Tympanoplasty in children: the Boston Children's Hospital experience. Arch Otolaryngol Head Neck Surg. 1990;116(1):35-40.
21. Komune S, Wakizono S, Hisashi K, Uemura T. Interlay method for myringoplasty. Auris Nasus Larynx. 1992;19(1):17-22.
22. Stage J, Bak-Pedersen Kr. Underlay tympanoplasty with the graft lateral to the malleus handle. Clin Otolaryngol Allied Sci. 1992;17(1):6-9.
23. Aoyagi M, Yokota M, Nakamura T, Tojima H, Kanayama R, Fuse T, Koike Y. Effects of aging on hearing results in tympanoplasty. Acta Oto-Laryngologica. 1994;114(511):81-6.
24. Scally CM, Allen L, Kerr AG. The anterior hitch method of tympanic membrane repair. Ear Nose Throat J. 1996;75(4):244-7.
25. Strauss P, Kress M, Hinz R, Wöhl K. Medial or lateral placement of the graft in myringoplasty comparative studies of both operation techniques using electronic data processing. Laryngol Rhinol Otol. 1975;54(3):183-90.
26. Sheehy JL, Glasscock ME. Tympanic membrane grafting with temporalis fascia. Arch Otolaryngol. 1967;86(4):391-402.
27. García RB, Suárez-Varela MM, Conejeros JM, Porras GA, Puchades VM, Galofre JD. Myringoplasties. A retrospective analysis of our surgical outcomes. Acta Otorrinolaringol. 2011;62(3):213-9.
28. Sakai N, Kokubun T, Asai T, Kurihara H, Nishizawa N, Matsushima JI, et al. Simple in-office closure of small intractable tympanic membrane perforations after myringoplasty. Auris Nasus Larynx. 1997;24(1):43-6.
29. Gibb AG, Chang SK. Myringoplasty: A review of 365 operations. J Laryngol Otol. 1982;96(10):915-30.
30. Vartiainen E, Kärjä J, Karjalainen S, Härmä R. Failures in myringoplasty. Arch Oto-rhino-laryngol. 1985;242:27-33.
31. Livi W, Piane R. Comparison of 2 materials in the reconstruction of the tympanic membrane. Our experience in 300 patients. Revue de Laryngol Otol Rhinol. 1992;113(2):137-9.
32. Gimenez F, Marco-Algarra J, Carbonell R, Morant A, Cano S. Prognostic factors in tympanoplasty: a statistical evaluation. Revue de Laryngol Otol Rhinol. 1993;114(5):335-7.
33. Gersdorff M, Garin P, Decat M, Juantegui M. Myringoplasty: long-term results in adults and children. Otol Neurotol. 1995;16(4):532-5.
34. Podoshin L, Fradis M, Malatskey S, Ben-David J. Tympanoplasty in adults: a five-year survey. Ear Nose Throat J. 1996;75(3):149-56.
35. Berger G, Ophir D, Berco E, Sadé J. Revision myringoplasty. J Laryngol Otol. 1997;111(6):517-20.
36. England RJ, Strachan DR, Buckley JG. Temporalis fascia grafts shrink. J Laryngol Otol. 1997;111(8):707-8.

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