

PHILOSOPHY AND CONCEPT OF TOTAL ANNULUS EXCISION (TAE): A NOVEL APPROACH FOR TYMPANOPLASTY

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Abstract

Tympanic membrane perforation is a common pathology encountered by an ear surgeon. The surgical repair and reconstruction of these defects of the drumhead has been addressed by two popular techniques - viz., the common and popular underlay technique and the lesser known interlay technique. In underlay technique of tympanoplasty, mucosalization of the graft many a times leads to continuous or intermittent discharging ear despite an intact tympanic membrane - and this has been called the "Red Drum Conundrum". Total annulus excision (TAE) implies that the entire annulus is removed along with remnant of tympanic membrane during the procedure to surgically reconstruct a diseased membrane. TAE is an essential step of a broader technique of interlay technique. This novel Interlay technique's basic premise is that - Once the graft is placed, there must not be any mucous membrane lateral to the graft and no epithelium medial to the graft. One very important benefit of TAE is neovascularization around the graft. Total annular excision is a new emerging technique of tympanoplasty as it gives patient a three layered physiologically and anatomically near natural membrane with good vibratory function without possibility of weeping membrane or granular myringitis.

KeyWords:

Annulus, tympanoplasty, interlay, middle ear, tympanic membrane, Myringoplasty

Introduction:

Tympanic membrane perforation is a common pathology encountered by an ear surgeon. All of us have seen the normal tympanic membrane and have also seen it moving with Siegel's pressure changing speculum. To see this same appearance and movement with the surgically reconstructed ear drum and give the gift of hearing back to the patient with a dry ear will surely warm the hearts of the observers. The most commonly used technique today to reconstruct the perforated tympanic membrane is the underlay technique. In this technique the graft is placed under the laterally raised annulus medial to the remnant of tympanic membrane after freshening of the perforation margins. This technique, especially in small and medium defects leads to the surgeon having to lay a large volume of mucous membrane lateral to the graft - and this can lead to a very distressing complication as will be outlined a little later.

The underlay technique of tympanoplasty fails to address the need for exactness in delineating the junction between the mucous membrane and the skin at the edges of the defect of the tympanic membrane before freshening of margins. This can leave mucous membrane on the lateral flap which is later laid lateral to the graft. Post tympanoplasty, mucosalization of the graft many a times leads to continuous or intermittent discharging ear despite an intact tympanic membrane. It has been every underlay ear surgeon's experience (including the authors) to have been faced with the dreaded postoperative "Red Drum Conundrum" - in at least one in sixty nine reconstructed tympanic membranes. In this dreaded complication, the postoperative ear drum is seen to be red, glistening, discharging and intact. Such eardrums will never settle down and will continue to trouble the patient endlessly- in spite of repeated ear canal cleaning and repeated attempts at chemical cautery. The only solution is revision surgery with excision of the "mucous membrane".

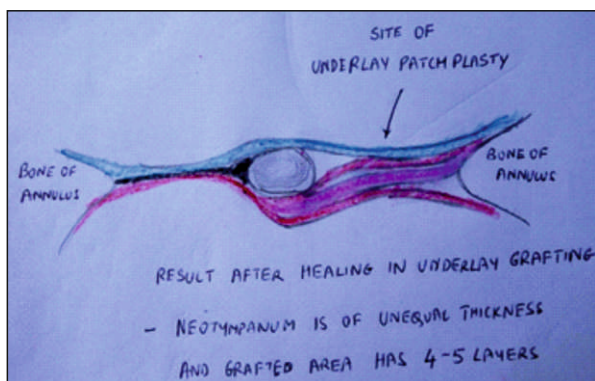


Fig 1. Result after Underlay Tympanoplasty

What happens in this red tympanic membrane is that the mucous membrane that is left lateral to the graft survives and proliferates- creating islands of discharging mucous membrane. This is called "granular myringitis" or "weeping tympanic membranes". In the more extreme cases the entire lateral surface of the surgically reconstructed

eardrum is formed by mucous membrane - and in such cases it must be postulated that during postoperative healing the mucous membrane grew at a faster rate than the epithelium- leading to tympanic membrane having mucosa on its lateral surface.

Philosophy:

One of the reasons for devising the new technique was the dissatisfaction with current techniques which are found to be unsatisfactory in terms of the end result achieved. The endeavor to surgically reconstruct the diseased tympanic membrane is one which is as close in appearance and function to the normal membrane without disease as is humanly possible. This implies that the new membrane must have only three layers in all quadrants and areas, and that its vibratory properties approach closely the vibratory properties of the normal membrane, and that it is the lateral wall of a middle ear air bubble, and that it is attached along the entire length of the handle of the malleus.

The TAE interlay technique came about with a view to correct the deficiencies of the underlay technique i.e. to prevent the dreaded red drum complication. The repeated exposure to so called "weeping tympanic membranes" pulled attention of the author of this article to think of possibilities by which such condition may be avoided. After years of attempt at addressing this problem, the author has come up with this novel technique - Total Annulus Excision (TAE) for tympanoplasty which has helped give patients a healthy, anatomically and physiologically near natural tympanic membrane.

Technique of TAE:

TAE implies that the entire annulus is excised during the procedure to surgically reconstruct a diseased membrane. TAE is an essential step of a

broader technique of grafting called the "Interlay Technique". This novel Interlay Technique's basic premise is that - Once the graft is laid, there must not be any mucous membrane at all lateral to the graft and , of course, no epithelium medial to the graft.

Steps:

Every step of the technique as described in the series of original line diagrams in course of article, designed to achieve the goal of the basic premise that underlies this Interlay technique.

First step is the approach to canal through post auricular, end aural or transcanal approach.

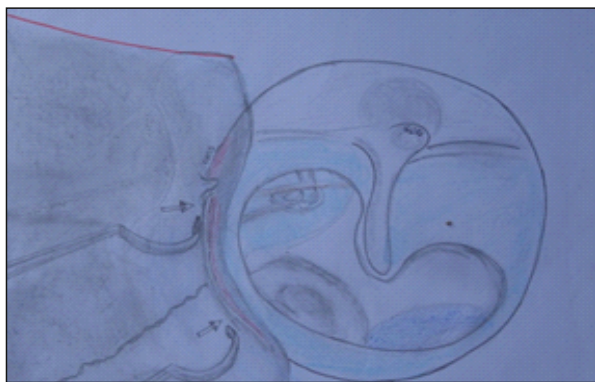


Fig 2. Second step: Raising TM flap upto the annulus at 360 degrees

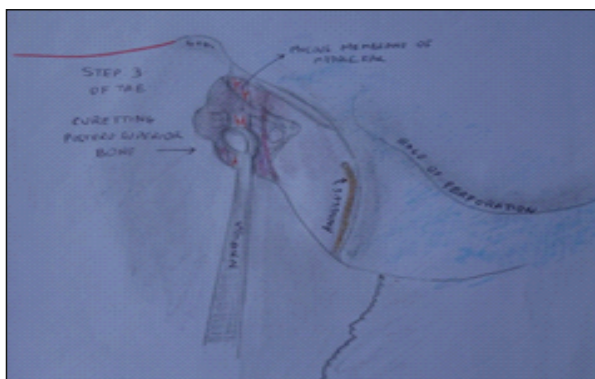


Fig 3. Third Step: Curetting postero superior canal bone to expose long process of incus.

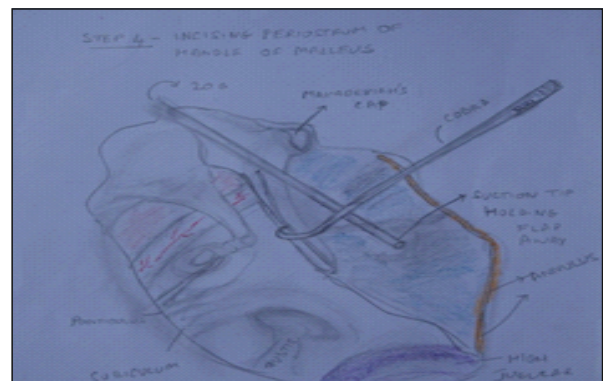


Fig 4. Fourth step: Incising periosteum of handle of malleus and denuding it completely of mucosa.

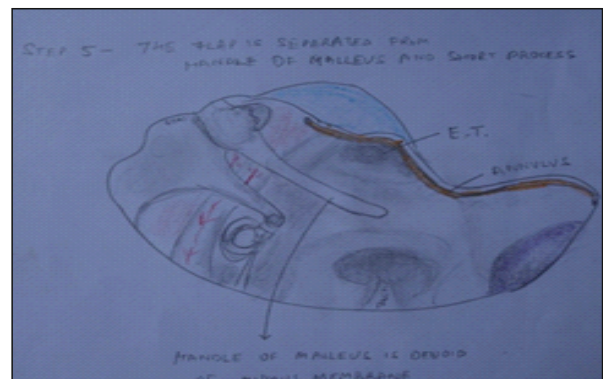


Fig 5. Fifth step: The flap is separated from handle of malleus and long process of incus

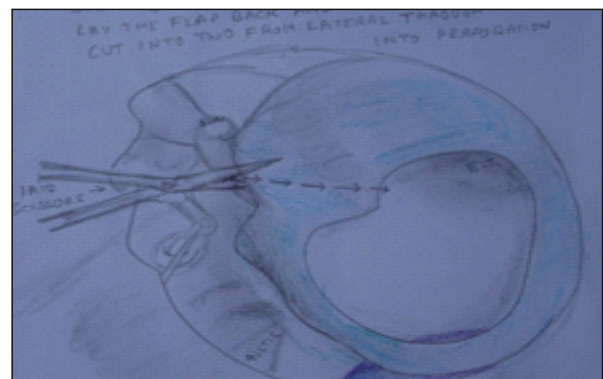


Fig 6. Sixth step: The flap is laid back and then divided into two from lateral end reaching perforation margin

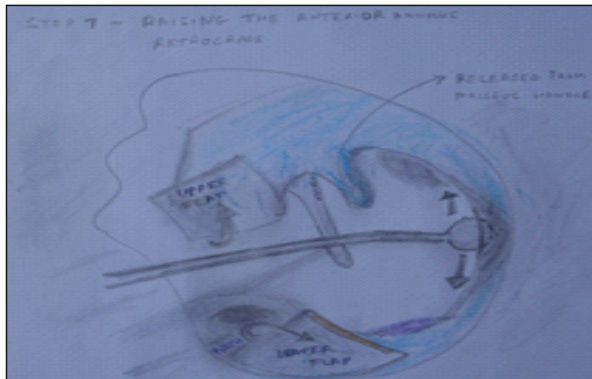


Fig 7. Seventh step: Anterior annulus is raised in inside out direction

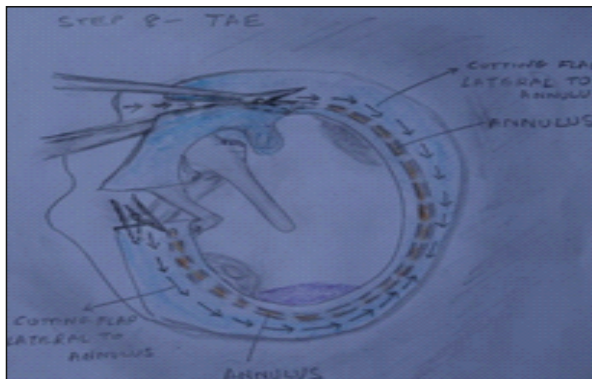


Fig 8. Eighth step: The whole annulus is removed cutting flap lateral to annulus



Fig 9. Ninth step: Skin over canal wall is raised all around

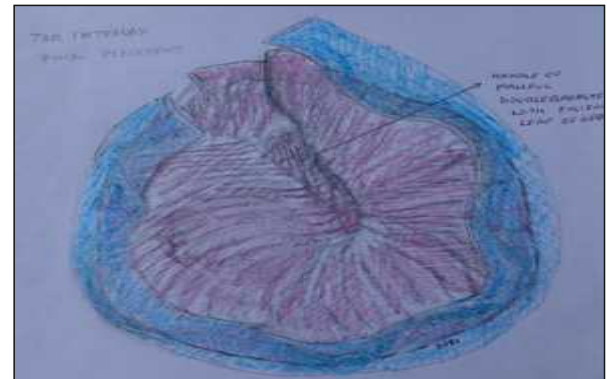


Fig 10. Tenth step: Graft placed on bone with handle of malleus lateral to graft

In the TAE interlay technique - the tympanomeatal flap is freed laterally from the malleus handle (when the malleus is present) - the entire 360 degree fibrous annulus is freed from its bony sulcus - and then, the junction between the ear canal skin and the mucous membrane is precisely defined. Once this is done, the entire remnant ear drum along with the entire annulus is excised, and the scissors will cut lateral to the junction between the mucous membrane and the epithelium if that junction is lateral to the annulus. Even otherwise the scissor cut will be lateral to the annulus, seeing as the annulus contains mucous membrane rests which we do not want to leave lateral to the graft which will be placed. After excision there must be no mucous membrane on the lateral flap and no epithelium medially. Subsequently, the graft is placed on bone 360 degrees and the lateral flap repositioned to hold the graft between itself and the bone of the external auditory canal. Once the graft is laid - there is no mucous membrane lateral to graft and no epithelium medial to graft. This is the essence of this TAE interlay technique.

Image 1. Excised annulus along with mucosal tissue over the annulus and the perforation.



TAE is a necessary adjunct because the annulus in the normal as well as the diseased eardrums harbors mucous membrane intimate with its surface - and leaving the annulus will be at odds with the basic premise of this technique - which is to ensure that there is no mucous lateral to the graft laid for reconstructing the diseased ear drum. Lastly - TAE is a guarantee that the annulus is not the limiting obstacle in seeking the lateral junction of the skin of the canal and the medial mucous membrane. A double blinded, randomized controlled trial done at SMS Medical college, Jaipur India using TAE interlay tympanoplasty, results of which were presented in 14th Asia – Oceania ORL- HNS Congress and 71st AOICON 2019 has been shown to lessen the risk of the result of a post operative discharging red ear drum manifold. The end result after healing in this TAE Interlay procedure is a trimeric tympanic membrane with equal thickness in all quadrants - and this trimeric tympanic membrane covers the handle of malleus (when present) between the outer epithelium layer and the inner mucous membrane layer , and the graft itself serves as a faux fibrous layer . The end result achieved is as close to nature as is possible in both form and function.

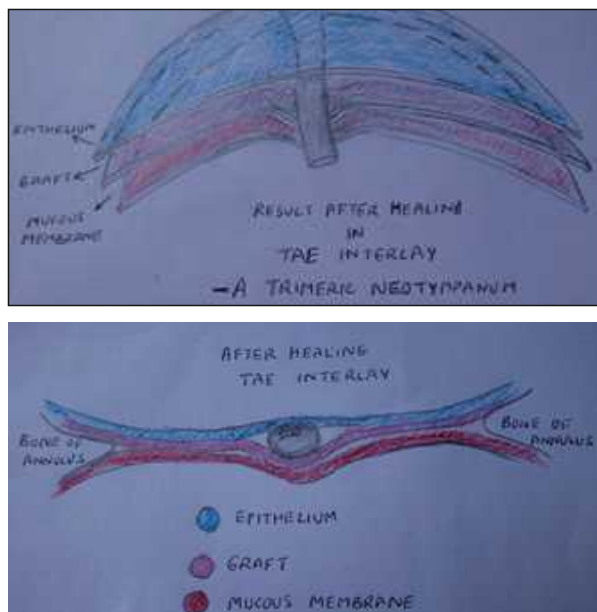


Fig 11. A and B: Result after TAE tympanoplasty

One very important benefit of TAE is neovascularization around the graft; the fibrous graft after being raised from bony annulus in conventional type of tympanoplasty can never be repositioned back in the bony annulus and hinders the vascularization of graft. Removal of annulus leads to easy revascularization.



Image 2: Post operative result of TAE

Conclusion:

Total annular excision is a new emerging technique of Interlay tympanoplasty which is promising as it gives patient a three layered physiologically and anatomically near natural membrane with good vibratory function and the new membrane has a good vascularity while remaining free of any mucosal islands like sometimes seen in conventional underlay technique.

Conflict of Interest:

The authors declare no conflict of interest of any sort and no financial disclosure.

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