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A Comparative Study on Results of Surgical Procedure i.e. Tympanoplasty by Using Temporalis Fascia and Cartilage Island as Autologous Grafting Material

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ABSTRACT

A high-risk perforation refers to a situation where a revision surgery is required, the perforation occurs in front of the annulus, the perforation is draining during operation, the perforation is more than 50%, or there is a perforation on both sides. The objective of this study was to compare the outcomes of graft uptake and hearing improvement between temporalis fascia and cartilage island tympanoplasty. The surgical procedure Tympanoplasty was conducted concurrently on a total of 60 patients who were attending St. Stephen's Hospital. The patients were separated into two groups, with each group consisting of 30 patients. In Group A, the surgery involved the use of temporalis fascia, while in Group B, cartilage island was used. The status of graft was evaluated 21 days after the procedure and the hearing exam was conducted 8 weeks following the surgery. This study demonstrates that the rate of cartilage island graft uptake in patients was 96.7%, but the uptake rate in the temporalis fascia group was 90%. However, there was no statistically significant difference between the two groups (p value >0.05). The average increase in air bone gap in the cartilage island group was 12±6.37 dB, while it was 14.33±6.66 dB in the temporalis fascia group. There was no significant difference between the two groups, with a p value greater than 0.05. Based on this, it can be inferred that when it comes to tympanoplasty, both cartilage island graft and temporalis fascia are equally effective as autologous graft materials.

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Key Words
Tympanoplasty, temporalis fascia graft, cartilage island graft, air-bone gap

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INTRODUCTION

Chronic otitis media (COM) is defined by the repeated ejection of fluid from the ear through a hole in the eardrum known as a Tympanic membrane perforation. It is a persistent inflammation of the mucoperiosteal lining of the middle ear, which includes the eustachian tube, tympanic cavity, attic, aditus and mastoid air cells. From a clinical perspective, chronic otitis media (COM) can be categorized into two distinct types: Tubotympanic type and Atticoantral type. The Tubotympanic COM is distinguished by the absence of cholesteatoma and is typically considered a safer form due to its reduced propensity to develop intracranial complications. On the other hand, the Atticoantral form is regarded as less secure due to its frequent association with cholesteatoma and its increased tendency to cause intracranial problems[1].

The issue can be rectified or improved either through conservative methods or with a surgical procedure known as tympanoplasty. The surgical procedure known as tympanoplasty was first introduced by Wullstein in the year 1952. This involves the restoration of the tympanic membrane to eliminate middle ear disorders and restore the hearing mechanism[2].The graft materials commonly employed in tympanoplasty include temporalis fascia, perichondrium/cartilage from the tragus/concha, areolar tissue and fat from the ear lobule, vein, cadaveric tympanic membrane/pericardium/ temporalis fascia/sclera, newer allograft material and gel films/fibrin glue in conjunction with a temporalis fascia graft[3].

In 1961, Storrs employed temporalis fascia graft to seal tympanic membrane perforation[4]. The temporalis fascia is the chosen graft for reconstructing the tympanic membrane due to its low metabolic rate, easy accessibility during surgery, low possibility for causing an immune response and its capacity to better resist extended lack of oxygen[5].

The utilization of perichondrium as a graft material was pioneered by Goodwill in 1964.Cartilage is employed due to its capacity to prevent post-operative graft keratoma (cholesteatoma) and achieve excellent survival rates, hence preventing post-operative perforations. Managing retraction pockets and high risk perforations has been advised in a restricted manner. The high-risk perforation includes a surgical procedure to correct a previous operation, a perforation occurring in front of the annulus, a perforation that is actively draining during surgery, a perforation that is greater than 50%, or a perforation occurring on both sides[6].

Aims and Objectives: To assess the auditory enhancement achieved through tympanoplasty employing temporalis fascia graft and cartilage island graft, specifically at the 8-week mark post-surgery.

To compare the efficacy of tympanoplasty by comparing the outcomes of employing temporalis fascia graft and cartilage island graft.

To assess other complications after surgery in both groups.

MATERIAL AND METHODS

This study, which was prospective and comparative, took place in a tertiary care hospital in Delhi, India. It involved a total of 60 patients and lasted for one and a half years, from November 2007 to April 2009. Prior to conducting the study, clearance was obtained from the Institutional Ethical Committee. All patients provided written informed consent. This study included patients aged 20 to 40 years who were in good overall physical condition, had no active infections in the nose, throat, or paranasal sinuses, had a central perforation of the pars tensa of the tympanic membrane, had a dry ear for at least 3 weeks prior to the operation, had good eustachian tube function and had good cochlear reserve. Patients who had eustachian tube blockage, polyps, granulations, cholesteatoma, a history of myringoplasty in the same year, otogenic intra cranial complications, otitis externa, otomycosis, disrupted ossicular chain during surgery, or skin disease in the post aural, temporal, or facial regions in front of the ear were not included in the study. The patients were randomly allocated into two groups, with each group consisting of 30 patients. Group A comprised patients who underwent tympanoplasty, with the temporalis muscle fascia used as the graft material. Group B comprised patients who had tympanoplasty, with the graft material being island cartilage. Each patient underwent a clinical examination to assess the presence of middle ear illness and the functioning of the eustachian tube. Additionally, tuning fork tests were performed. A pure tone audiometry was conducted to assess their pre-operative Air conduction (AC), Bone conduction (BC) and air-bone gap (ABG), which were recorded.

In Group 'A', a 3×3 cm Temporalis fascia graft was obtained using either the postauricular William Wilde's or Lempert's endaural method, as depicted in Fig. 1. A self-retaining mastoid retractor was positioned in the upper portion of the incision, while the uppermost part of the incision was also retracted using a double hook retractor. The dissection was performed until the temporalis fascia was reached using a blunt technique. A minute quantity of saline was administered to distend the fascia, creating separation from the muscle. The fascia was distinguished by its white lustrous hue. The sufficiently large fascia was excised using scissors and thereafter compressed and

expanded. The underlay approach was utilized to position the graft beneath the handle of the malleus. Gel foam was inserted into the anterior mesotympanum. The external auditory canal was filled with gel foam.

In Group 'B', the perichondrial/cartilage island flap was obtained from either the tragal or conchal cartilage, as seen in Fig. 2. A cut was made on the skin of the inner side of the tragus. A 15×10 mm cartilage fragment, along with its connected perichondrium, was carefully separated. A small incision was made behind the ear, specifically over the cymba concha, to perform the conchal cartilage island flap procedure. A piece of cartilage was taken from this area to use as a graft. The perichondrium located on the side of the cartilage farthest from the ear canal was carefully removed, while the perichondrium on the opposite side was left intact. The round knife was utilized to excise cartilage, resulting in the creation of a disc of cartilage with an off-center position. This disc will be used to repair a defect in the tympanic membrane. A 2 mm wide strip of cartilage was excised vertically from the central region to create space for the full malleus handle. The cartilage was employed as a graft with full thickness, usually measuring slightly under 1 mm in thickness in the majority of instances. A posteriorly oriented perichondrial flap was generated, which subsequently covered the posterior wall of the canal. The endomeatal method was employed and the graft was positioned using the underlay technique. A gel foam material was inserted into the middle ear space beneath the annulus in order to provide support for the graft. The external auditory canal was filled with gel foam. In both groups, the external canal was debrided of gel foam after 21 days and the condition of the graft was evaluated. An auditory evaluation was onducted after a period of 8 weeks.

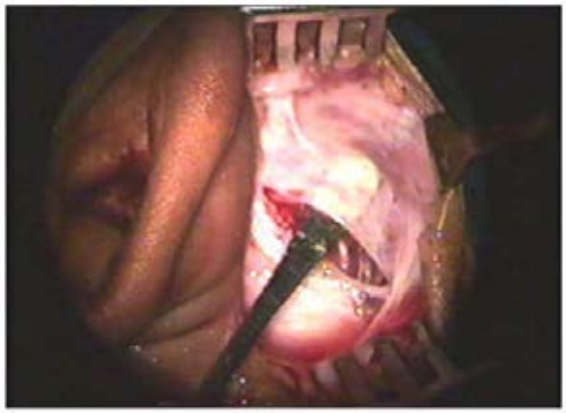

Fig. 1: Harvesting of temporalis fascia

Fig. 2: Harvesting cartilage graft

RESULTS

Out of 60 patients, there were 13 males and 17 females in the temporalis fascia group and 18 males and 12 females in the cartilage island group. Maximum number of patients in each group belonged to younger age group, i.e., 20-25 years. The years since onset of disease in majority of patients in temporalis fascia group was 3 months-5 years (60%) and in cartilage island group was 3 months-5 years (50%), as shown in Table 1.

In the vast majority of cases, the onset occurred following an episode of acute suppurative otitis media. Within both groups, 90% of patients had a history of purulent ear discharge, while 10% displayed a history of non-purulent ear discharge. All 60 patients had a documented history of hearing loss. 43.3% of patients in the temporalis fascia group had a history of ear discomfort, compared to just 30% of patients in the other group. About 16.7% of the patients in the temporalis fascia group and 20% of the patients in the cartilage island group reported a history of tinnitus. Neither group had a prior history of vertigo. Among the patients in the temporalis fascia group, 23.3% had bilateral disease, while in the cartilage island group, 33.3% of patients had bilateral disease. Within the temporalis fascia group, 53.3% of patients underwent surgery in the left ear, while 47.7% had surgery in the right ear. Within the cartilage island group, 55.7% of patients underwent surgery in the right ear, while 44.3% had surgery in the left ear. Within the temporalis fascia group, 50% of patients exhibited grade II perforation, 33% had grade III perforation and 13.3% had grade IV perforation. In the cartilage island

Table 1: Years since onset

Years Since Onset (Years)	No. of Patients	
	Temporalis Fascia Group	Cartilage Island Group
3m-05	18	15
06-10	4	2
11-15	4	8
16-20	1	3
21-25	1	1
26-30	2	1
Total	30	30

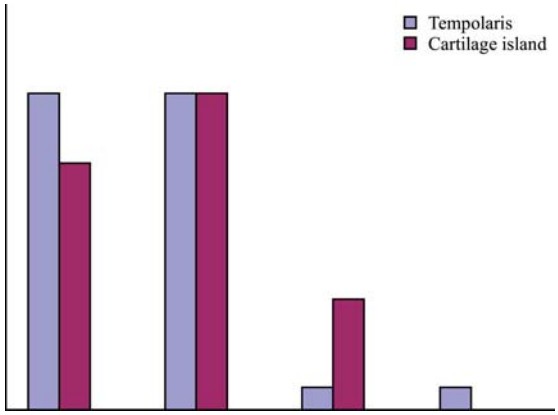

Fig. 3: Post Operative AB Gap

Table 3: Pre Operative A-B Gap

Pre-Operative AB gap (dB)	No. of Patients: Temporalis Fascia Group	No. of Patients: Cartilage island Group
1-10	0	1
11-20	5	8
21-30	18	15
31-40	7	6
Total	30	30

Table 4: Post operative AB gap at 8 weeks

Post-operative AB gap (dB)	No. of Patients: Temporalis Fascia Group	No. of Patients: Cartilage island Group
0-10	14	11
11-20	14	14
21-30	1	5
31-40	1	0
Total	30	30

Table 5: Complications at Donor site

Graft taken up	No. of Patients: Temporalis Fascia Group	No. of Patients: Cartilage island Group
Yes	27	29
No	3	1
Total	30	30
Complications at Donor site	**Temporalis Fascia Group**	**Cartilage island Group**
Pain	6	0
Deformity	0	0
Wound infection	0	0

group, 46.7% had grade II perforation, 26.7% had grade III perforation and 16.7% had grade IV perforation, as indicated in Table 2.

The majority of patients in both groups, specifically 65% in the temporalis fascia group and 45% in the cartilage island group, had a preoperative air-bone gap (AB gap) ranging from 21 to 30 decibels (dB), as indicated in Table 3.

Among patients in the temporalis fascia group, 46.7% experienced a post-operative air-bone gap (AB gap) of 0-10 decibels at 8 weeks. In the cartilage island group, the majority (46.7%) had an AB gap of 11-20 decibels, while 36.7% had an AB gap of 0-10 decibels. These findings are presented in Table 4 and Fig. 3.

Within the temporalis fascia group, 60% of patients experienced a gain of 11-20 dB, whereas 33.3% had a gain of 0-10 dB and 6.7% had a gain of 21-30 dB. Within the cartilage island group, 60% of patients saw an increase in hearing of 11-20 decibels, whereas 40% reported a gain of 0-10 decibels. There was no discernible disparity in the increase of AB gap achieved when used either temporalis fascia or cartilage island as graft material in tympanoplasty. The temporalis fascia group exhibited a graft uptake rate of 90%, whereas the cartilage island group demonstrated a higher rate of 96.7%, as indicated in Table 5. There was no statistically significant difference seen between both groups, since the p value was greater than 0.05. Medialization of the graft was observed in four patients from the temporalis fascia group, but not in the cartilage island group. Among the patients in the temporalis fascia group, 6 individuals reported experiencing discomfort at the donor site. However, none of the patients in the cartilage island group reported any pain at the donor site, as seen in Table 5.

DISCUSSION

Chronic suppurative otitis media is a prevalent disease in our nation. The majority of CSOM cases are classified as either safe or tubo-tympanic, characterized by the presence of a central perforation in the tympanic membrane. The condition results in auditory impairment and frequent discharge from the ear, which adds to the overall morbidity in the population. The patient experiences social difficulties as a result of their deafness and feels embarrassed by the discharge from their ears. These people seek the assistance of ENT surgeons to alleviate these problems. Tympanoplasty is a surgical procedure used by ENT surgeons to treat these patients. Not only does it provide the patient with a moisture-free ear, but it also enhances the hearing abilities of the majority of patients.

Multiple graft materials have been employed by different surgeons to cover the perforation in the tympanic membrane. Currently, temporalis fascia is the most frequently utilized graft material. To harvest this, either the postaural incision is slightly extended above or a separate incision is made on the scalp. In cases of revision surgery where the temporalis fascia has already been harvested, it can be challenging to extract it again without extending the incision over the ear. However, the cartilage island graft is conveniently accessible in the local area, possesses durability and can be easily obtained through a tiny incision made on the inner surface of the tragus. Furthermore, the resulting scar is not discernible from the exterior. In circumstances when temporalis fascia has previously been harvested, the cartilage island remains available as a graft material. This thesis was conducted to evaluate the effectiveness of Cartilage Island with that of temporalis fascia.

An observation was made that the percentage of acceptance of temporalis fascia was 90%, however the rate for cartilage island was 96.7%. This finding aligns with earlier studies conducted by Güneri *et al*.[7], Ozbek *et al*.[8] and Wielgosz *et al*.[9]. There was no discernible disparity in the closure of the perforation when any type of graft material was utilized. The disparity in uptake seen in our study could perhaps be attributed to a type-II error. In a study conducted by Jyothi *et al*.[10], it was shown that temporalis fascia had a graft uptake rate of 84%, while tragal perichondrium had a graft uptake rate of 80%. In a study conducted by Kazikdas *et al*.[11], the palisade cartilage group achieved a graft uptake rate of 95.7%, whereas the temporalis fascia group achieved a graft uptake rate of 75%.

The drum that was transplanted in the cartilage island group was entirely opaque, preventing us from conducting a middle ear examination. However, we may analyze the temporalis fascia grafted drum together as a group. A further drawback of the cartilage island graft is the restricted size that can be harvested from the tragus, whereas the temporalis fascia graft does not have this constraint. Medialization of the graft was observed in four patients from the temporalis fascia group, but not in the cartilage island group. The cartilage island group, which had a higher concentration of fibrillar collagen material, exhibited increased resistance to medialization when the drum was transplanted.

The average increase in the A-B gap for patients who received tympanoplasty using cartilage island graft material was 12±6.34 dB, whereas patients who received temporalis fascia graft material had an average increase of 14.33±6.66 dB. Upon closer examination, it was observed that the t value was 1.36, indicating that there was no statistically significant distinction in the increase of the air bone gap between the two groups. The study conducted by Sapçi *et al*.[12] revealed that there was no notable disparity in auditory improvement between temporalis fascia and cartilage tympanoplasty. According to Cayé-Thomasen *et al*.[13], their investigation revealed that the average PTA (pure-tone average) for type-1 tympanoplasties was 12.2 dB for the cartilage palisades group and 13.5 dB for the fascia group. The difference between the two groups was not statistically significant.

Among the patients in the temporalis fascia group, 6 individuals had pain at the place where the graft was taken, which could potentially be attributed to muscle damage during the harvesting process. Pain resolved within duration of 3 weeks in the majority of patients, while one patient experienced persistent pain for a period of 8 weeks. The process of constructing the cartilage assembly yields consistent results in terms of both anatomical and functional considerations, but it is both intricate and time-consuming. Our investigation revealed that there was no statistically significant difference between the two groups in terms of graft uptake and ABG closure. Nevertheless, the group that received island cartilage grafts exhibited higher rates of graft acceptance, lower levels of hearing improvement and reduced discomfort at the donor site compared to the group that received temporalis fascia grafts.

CONCLUSION

Tympanic membrane perforation can be remedied with the utilization of either temporalis fascia or island cartilage graft. Cartilage graft is considered a superior autograft for large or subtotal perforations. Our investigation revealed that the rates of graft incorporation and improvement in sound amplification are similar in both the temporalis fascia and island cartilage graft groups. It can be deduced that cartilage island is an equally, if not superior, graft material compared to temporalis fascia for tympanoplasty.

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