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Merits and demerits of transcanal tympanoplasty: an observational study

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ABSTRACT

Background: Chronic suppurative otitis media characterized by ear discharge, membrane perforation and hearing impairment is a major cause of deafness in India. Tympanoplasty with or without mastoidectomy done by postaural, endaural or transcanal approach is the treatment. Each approach has its advantages and limitations. The transcanal approach is becoming more popular today. A detailed study on the merits and demerits of the transcanal approach to tympanoplasty could not be found in the literature. This study compares this with the postaural approach. The study is aimed to evaluate the merits and demerits of transcanal tympanoplasty.

Methods: This study comparing transcanal versus postaural approach in tympanoplasty was carried out between April 2014 and April 2015 for 12 months. A total of 50 patients were divided into two groups (25 each in a group) and compared 11 parameters.

Results: Out of 11 parameters, 5 showed a statistically significant difference between the two, favouring transcanal approach. However, surgical results were similar.

Conclusions: Transcanal approach has more merits and fewer demerits than others for tympanoplasty, with equal hearing results.

Keywords: Chronic suppurative otitis media, Transcanal approach, Tympanoplasty

INTRODUCTION

Chronic suppurative otitis media (CSOM) is the chronic inflammation of the mucoperiosteal lining of the middle ear cleft characterized by ear discharge, a permanent perforation of the tympanic membrane and impairment in hearing. It is a major cause of deafness world over. Tympanoplasty is the procedure to control disease in the middle ear and reconstruct the hearing mechanism, with tympanic membrane (TM) grafting. This procedure can be combined with either an intact canal wall or a canal-wall-down mastoidectomy to control the disease from the mastoid area. Tympanoplasty can be considered the final step in the surgical conquest of conductive hearing loss and represents the culmination of over 100 years of

evolution of surgical procedures on the middle ear to improve hearing.¹

The endaural, postaural and transmeatal incisions are the most commonly used surgical approaches for tympanoplasty. Each incision has its advantages and limitations so that no single approach is the best approach for all tympanic membrane perforations.² Though the classical teaching is that “factors to be considered regarding the type of approach to be used include the size of the ear canal, the location and size of the perforation and the surgeon’s training and experience” the transcanal approach is becoming more popular today and preferred by otologic surgeons especially to reduce the cost of hospitalizations by doing day care surgeries,

tympanoplasties in children and the recent trend of coupling endoscopes for middle ear surgeries where a transcanal approach gives a wider panoramic view of the middle ear as compared with postaural approach. It is the standard approach for stapes surgery.³

The merits and demerits of transcanal approach as compared with the classical postaural approach for tympanoplasty is the essence of this study. A detailed study on the merits and demerits of transcanal approach to tympanoplasty could not be found in the literature. Hence this study was undertaken to evaluate the merits and demerits of this approach in tympanoplasty as compared with the other popular approach, i.e., postaural approach. It was undertaken as an observational study on 50 patients admitted and operated in Yashoda Super Speciality Hospital, Hyderabad.

METHODS

This study was conducted for 12 months between April 2014 and April 2015 at Yashoda Superspeciality Hospital, Hyderabad, Telangana state, India, after obtaining Institutional Ethics Committee approval. The study group comprised of 50 patients of both sexes belonging to a semi-urban population. They were randomly selected from those who attended the ENT OPD having ear discharge, hearing loss and perforation and planned for tympanoplasty during this period. Inclusion and exclusion criteria were drawn up. Patients aged between 18 and 70 years were included. Patients with active disease or squamous type or with complications, more than minimal ossicular damage or had previous major ear surgeries and with deformities of the external auditory canal were excluded. The sample size was calculated using a statistical formula and found justified. The patients were randomly distributed into two groups with 25 each, Group-1 who would be operated by transcanal approach and Group-2 to be operated by postaural approach. This was done using the research randomizer tool available on the internet to create randomization codes. All patients signed the informed consent form as per the Institutional Review Board or Independent Ethics Committee. A detailed history, general examination and a complete ENT examination was done including tuning fork tests. Investigations were done to arrive at the correct diagnosis. Routine blood and urine examination, radiological investigations of X-ray/CT mastoids and X-ray PNS, aural examination under a microscope, pre-operative audiometry, post-operative audiometry at 1 month, 3 months and nasal endoscopy to rule out any nasopharyngeal pathology were done.

The tympanoplasty was done under local anaesthesia or general anaesthesia after obtaining written informed consent from each patient. General anaesthesia was used for all postaural cases. Transcanal approach with underlay technique was used in 25 cases and postaural approach with underlay technique in the other 25 patients. The external auditory canal was classed as wide,

allowing visualization of the whole TM through a large ear speculum or narrow when the whole TM was not visualized easily and a large ear speculum could not be placed.

After preparation of the patient by shaving of hair of the post auricular region, xylocaine test dose and a pre-operative dose of antibiotic was given, patients were operated under local anaesthesia, were pre-medicated 10 minutes before surgery on the OT table. One ampoule (0.2 mg) of glycopyrrolate, fentanyl 2 µg/kg, dexmedetomidine 1 µg/kg and ondansetron 4 mg were given by IV injection. Local infiltration was done with 2% lignocaine with 1:200,000 adrenaline. Incision was either transcanal or postaural. Harvesting of the temporalis fascia graft done in transcanal cases with a 2.5 cm incision transversely placed 1 cm above ear attachment. Temporalis fascia graft was used to reconstruct TM in all cases with cartilage re-inforcement in cases with adhesive changes. Cartilage was used in all cases where ossicular reconstruction was required. TM was visualized and prepared. In transcanal approach cases, 6 o'clock and 12 o'clock incision was taken about 5 mm away from the annulus. A vascular flap was developed in the canal in cases to be done by postaural approach and an incision 5 mm behind the postaural groove from 1 cm above the pinna attachment down till mastoid tip, i.e., about 7-8 cms in length was made. It was extended upwards above ear attachment 1 cm and graft harvested. This incision was deepened through periosteum to bone and pinna pulled forward with vascular flap and fixed with gauze ribbon to drapes. The tympanomeatal flap was elevated and middle ear inspected, the status of ossicles noted-for both approaches, the further steps from here being the same till closure. Round window reflex was visualized and continuity of ossicular status confirmed and the graft placed. Repositioning of the tympanomeatal flap was done. Gel foam soaked with betadine was placed in the external canal. Periosteum, subcutaneous tissue and skin was sutured in two layers using 3'0 vicryl for deeper layer, and 3'0 monocryl for a skin for post aural approach (8-10 skin sutures) and the mastoid dressing was done. For transcanal graft harvest site single layer closure (3-4 sutures) was done with 3.0 monocryl. The time taken for surgery and blood loss was noted in each case (number of mops used). It was considered eligible when only one or two gauze pieces were used, mild when one mop was soaked fully and moderate if 2 mops were used. Post-operatively transcanal patients were discharged, with a small dressing over the wound the very next day. The postaural patients were discharged depending on their morbidity factors like pain, fever and ability to care for the postaural wound, next day or later. Suture removal was done after one week. Any post-operative morbidity was taken. They all continued antibiotic injections for a week changed to oral antibiotics for another week. All patients were followed up routinely after the surgery. These patients were evaluated for graft uptake and post-operative morbidity for up to 3 months and pure tone

audiometry obtained at 1 month and 3 months. Successful graft uptake was defined as having no perforation, retraction or lateralisation of TM graft as assessed by otoscope. Parameters of comparison between the 2 approaches were: ease of access, time of surgery, length of incisions and closure time as well as material costs, bleeding, adequacy of exposure of middle ear, relevance of canal width, size and site of perforations, ease of graft placement, anaesthesia exposure, extensibility of access to other areas e.g., mastoid and healing factors like time, complications, post-operative morbidity, graft take and hearing results.

Statistical analysis

The results were evaluated in the form of graft uptake, hearing outcome and morbidity. Healed neo-tympanic membrane, which moved on seigilization was taken as successful graft take-up, while any residual perforations or retraction of neo-tympanum were taken as failures. Postoperative and preoperative pure-tone audiograms were compared. Hearing gain and mean residual gaps

were evaluated in speech frequencies of 500, 1000, and 2000 Hz. A-B gap was calculated by taking the averages of bone conduction and air conduction at the frequencies of 500, 1000 and 2000 Hz. Qualitative data were presented as percentages. Quantitative data were presented as mean±standard deviation. All the major parameters drawn up to compare the two approaches, including the overall pre and post-operative PTA-ABG and ABG closure were analyzed by students 't' test and using the software Windostat version 9.2. Here p-value was calculated, and p-value of <0.05 was taken as significant.

RESULTS

In our study the maximum number of patients fell in the 31-50 years age group (50%) with a mean age of presentation of 33.26 years. Sex distribution of cases in our study was 1:1.08 with more number of females than males in agreement with both the above studies. Regarding the side of the presentation, we found 52 % of cases had left ear problem and 48% right ear.

Table 1: Analysis showing comparison of various parameters between transcanal and postaural approaches.

Variable	Trans-canal	Post-aural	T-test	Probability	Mann Whitney	Probability
Age	35.400±11.449	31.120±9.989	1.408	0.165	237.000	0.070
Sex	1.520±0.510	1.480±0.510	0.277	0.783	304.000	0.433
Side	1.480±0.510	1.480±0.510	0.000	1.000	292.000	0.345
Time (Sx+GA)	72.000±19.843	135.600±27.550	9.366	0.000	***	39.000
Time (Inc+Graft + clos.)	9.800±1.633	42.800±5.017	31.275	0.000	***	0.000
Anaesthesia	1.040±0.200	2.000±0.000	24.000	0.000	***	
Blood loss	1.000±0.000	2.560±0.507	15.396	0.000	***	
Postoperative morbidity	0.080±0.277	1.360±1.411	4.452	0.000	***	40.000
PTA-ABG (Preop)	24.560±9.372	24.400±9.201	0.061	0.952	311.000	0.488
PTA-ABG (Postop)	11.280±6.655	10.560±5.966	0.403	0.689	282.000	0.275
Graft uptake	0.000± 0.000	0.040±0.200	1.000	0.322		

From our statistical analysis, it is evident that all these 3 parameters had no statistical significance when comparing transcanal with postaural approaches for tympanoplasty ($p>0.05$). Regarding presentation, the commonest complaint was with hearing loss (92%) followed by ear discharge (66%) and then tinnitus (26%) and pain (24%). The majority of cases in our study had a centrally placed perforation (68%) and moderate large in size in 88%. General anaesthesia (GA) was employed for the larger majority of patients, 52 % which included all 100% of the postaural group and 1 patient, i.e., 4 % of the transcanal group (Figure 1). On statistical analysis, this is a very significant comparison between the two approaches with $p<0.05$. Of cases in the transcanal group,

96 % could be operated with local anaesthesia. Local anaesthesia (LA) with sedation is a well-established approach used for tympanoplasty. However, considering postoperative morbidity, only 8% of transcanal patients had any, which was only pain while 76 % of patients in the postaural group had one or the other problems (Figure 2).

10 patients complained of persistent pain for 2-3 days, 5 had persistent numbness for almost 3 months, 1 each had wound infection, dehiscence of the post aural wound and granulation. We find in our study that the difference in postoperative morbidity between the two groups is statistically significant with a p-value <0.05. Regarding

ABG closure, a total of 50 patients, 24 had Pre-op ABG between 10- 20 dB and 15 between 21-30 dB. There were only 5 patients with ABG 31-50 dB. Mean Pre-op ABG was 23.98 dB. A Post-op ABG of within 10 dB was achieved for an equal number of patients in both our groups, 17 in each, 68% of the total cases, while 20% of the total achieved 10-20 dB closure. Mean ABG closure in each group was 13.28 transcanal and 13.84 postaural. This difference is not statistically significant as the analysis shows a $p > 0.05$.

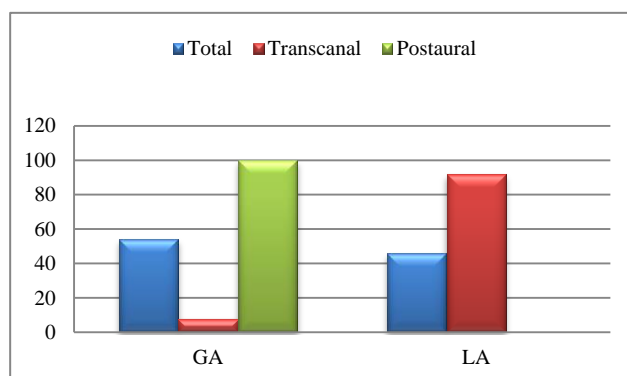


Figure 1: Distribution of cases according to anesthesia given.

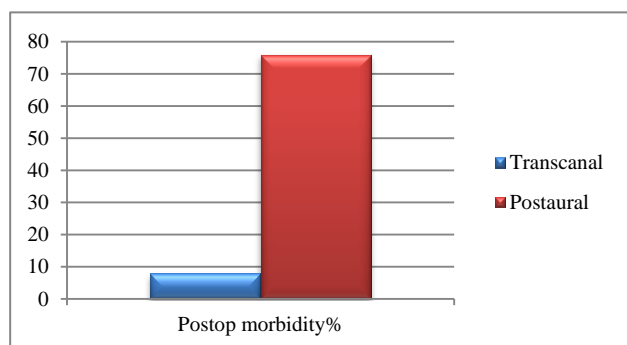


Figure 2: Comparison of post-operative morbidity.

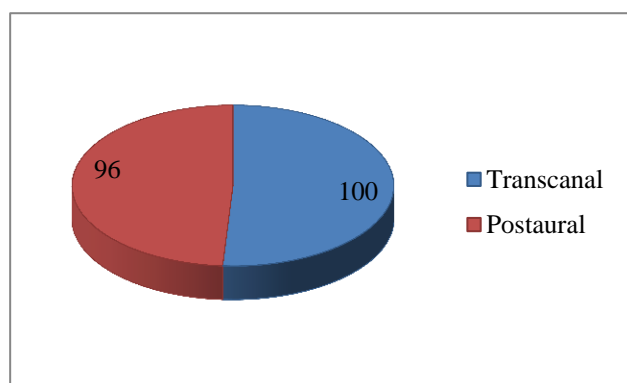


Figure 3: Graft uptake.

Comparing graft uptake between the approaches, we found it 100% in the transcanal group and 96% in postaural group (with an overall rate of 98%) which was

not statistically significant with p value > 0.05 (Figure 3). A statistical analytic comparison of our two groups, transcanal and postaural approach considering 11 parameters, clearly show that only 5 of them have statistical significance (Table 1).

DISCUSSION

Tympanoplasty procedure is a very oft evaluated surgery in its various aspects, especially regarding types of repair, materials for grafting, factors affecting results and audiological outcome. However, studies regarding the detailed evaluation of approaches and a comparison between the different approaches about various specific parameters, not just hearing or graft uptake, have not been forthcoming in literature. Hence the relevance for a study of this nature comparing specific parameters with data the two more popular approaches in tympanoplasty, transcanal and postauricular approaches. General findings common to both are also discussed. The mean age of presentation of 33.26 years in contrast to studies by Fadl, Shetty who found a mean age of presentation of 26.3 and 23.5 years, respectively.^{4,5} Giddiness was complained by only a small group (6%) of patients. This in agreement with the findings of Gupta et al, who found hearing loss in 100% and discharge in 72% and tinnitus and giddiness in the same proportion as in our study.⁶ Shetty also had similar findings in the presenting symptoms.⁵ Though ear discharge is more common a feature in CSOM, hearing loss brings the patient for surgical correction more than any of the other symptoms. The external auditory canal was adequately wide in 84% of cases and narrow in 16%. Our study compares with similar findings by Shetty and Kumar.^{5,7} Traditionally though it was thought that size and site of perforation affected hearing results, most recent studies reviewed in literature do not show any significant impact of size or site of perforation on hearing results, Singh et al, Sharma et al and Shaikh et al.⁸⁻¹⁰ Regarding the procedure done, the majority of patients, i.e., 68 % had type 1 tympanoplastic repair. Cartilage tympanoplasty was done in 28% cases that had adhesive changes in their TM. We routinely harvest tragal cartilage for TM support if needed, and cartilage /refashioned incus for ossiculoplasty. Type 2 and type 3 tympanoplasty were required for 1 case each in our study, i.e., 2% each of the total number of cases. The results are consistently better with these autogenic graft materials than alloplastic materials. The autogenic ossicle or cartilage grafts are biocompatible, inert, inexpensive, allow tissue in growth, easier to handle and stabilize with long-term hearing improvement. This opinion is shared by Mahadevia et al.¹¹

GA was employed for the larger majority of patients. LA with sedation is a well-established approach used for tympanoplasty. Sedation and analgesia here are achieved with either midazolam or dexmedetomidine in modern day-care surgeries. Dexmedetomidine is a new drug which acts on α_2 -adrenergic receptors in the dorsal horn of the spinal cord to produce adequate analgesia and

conscious sedative effect without respiratory depression. It has been reported to significantly reduce the opioid requirements both during and after surgery, according to Verma et al.¹² Compared with midazolam, it gives better haemodynamic stability and patient satisfaction according to a study by Vyas et al.¹³ Various published studies suggest that dexmedetomidine provides adequate sedation with analgesia and good surgical and patient comfort without any adverse effects for patients undergoing tympanoplasty under local anaesthesia. The amount of blood loss during surgery, which also amounts to a better oligoemic field, especially in middle ear surgery was also significantly lesser with this drug in a study by Gupta et al.¹⁴ Propofol usually used in the induction of GA is associated with the increased requirement of post-operative rescue analgesic and increased intraoperative hemodynamic instability (hypotension).¹² We did not have to use fentanyl as rescue medication in the post-operative period for any of the transcanal patients but had to use for some postaural patients. Surgery under LA with monitored anaesthetic care had the advantages of less operating time, blood loss, clearer field, quicker post-operative recovery and patient comfort, lesser demand on nursing care, lesser overall cost of surgery, avoiding exposure to potentially dangerous additional drugs like propofol and sevoflurane which are routinely used in GA as well as avoidance of intubation.

Regarding total operating time, the cases that took more than 2 hours were all done by postaural approach, i.e., 40% of the total while 24% took less than 1 hour in all. They were all transcanal cases, and 36% of cases took between 1-2 hrs, had cases belonging to both groups. The mean total time for each group was: transcanal-1 hour 12 minutes, postaural-2 hours 32 minutes.

The difference is marked and could be attributed to the extra half hour approximately taken for induction, intubation, extubation, recovery as well as postaural longer and deep-down-to-bone incision, graft harvest through this and closure of this in 2 layers and management of bleeding (which is more in postaural cases as well as cases done in GA) in the postaural group all of whom took 2 hours or more in total. In the cases done by transcanal approach, these factors were absent. Vagaries that are common to all surgeries probably accounted for some of the transcanal cases taking more than 1 hour. In this modern era of day-case surgeries and nuclear families where people have lesser time, money and support systems to afford longer hospital stay and larger hospital bills, this time difference is very significant. Time translates to money, both in terms of anaesthesia as well as OT time. Statistically, too, the difference with a p-value of 0.000 is significant. Comparing the time taken for incision, closure and graft harvest, all the cases done by postaural approach took more than 10 minutes, and all but 2 of the transcanal group took less than 10 minutes. The mean time taken by each approach was: transcanal-9.8 minutes, postaural-41

minutes. This compared well with the results of Moras et al, in their study on postaural incision closure.¹⁵ In comparison, the transcanal group had a 2-2.5 cm incision above the root of pinna within the hairline with the graft accessed easily and closure with 3-4 sutures in a single layer which took a maximum of 10 minutes. The materials used for both approaches have also been noted, with transcanal approach requiring only half a 3.0 monocryl while postaural approach required 1 vicryl 3.0 and 1 monocryl 3.0. When the cost of suture material alone was calculated, with each unit of 3.0 vicryl costing Rs.550 and 3.0 monocryl Rs.540, transcanal closure costs Rs.270, while postaural approach closure costs about Rs.1100 at present standard Indian prices. This shows postaural approach closure costs 4 times more than transcanal closure, in material cost alone, which is very significant. Comparing blood loss, it was negligible in all 100% our cases done by transcanal approach while it was mild-moderate in cases done by postaural approach. This was statistically significant. Review of available literature did not reveal any studies in this regard except for general descriptions like "less" or "more" blood loss. In view of postoperative morbidity, only 8% of transcanal patients had any, which was only pain while 76 % of patients in the postaural group had one or the other problems. Also, 10 patients complained of persistent pain for 2-3 days, 5 had persistent numbness for almost 3 months, 1 each had wound infection, dehiscence of the post aurial wound and granulation. This is in contrast to the outcome of Moras et al, who found postoperative morbidity of 4% accounted for by wound infection and dehiscence in their cases.¹⁵ Review of literature did not reveal any study mentioning all post-operative morbidities of either approach, only mentioning some significant complications though we feel from the patients' point of view, any morbidity is significant because it affects their ability to go for work as well as quality of life which is a major issue in all studies on surgical or other treatment modalities in the present era. Investigating cutaneous sensory deficit, Kang et al found that the sensation of the pinna returned to baseline within 3 months for sulcus incisions.¹⁶ However, a questionnaire-based study by Frampton et al, where the type of incision was not specified found that 26% of patients had persisting numbness beyond eight months.¹⁷ Granulations and granuloma formation in the canal are mentioned by Sharma et al in the postaural approach, wound infection leading to loss of graft is mentioned by both Shetty and Fadl.^{4,5,9} Singh et al report vertigo in 10% of their patients and infection in 1 patient.⁸ Sismanis has mentioned the inconvenience of the mastoid dressing and the slightly higher morbidity of the postauricular incision (pain, haematoma and infection) associated with the postauricular approach.¹⁸ Moreover, mean post-op ABG was 10.38 dB. This was better than the result of 40 dB achieved by Tos.¹⁹ Mean ABG closure in each group was 13.28 transcanal and 13.84 postaural. Similar results were reported by Singh et al, who with a pre-op ABG of 28.72 and postoperative ABG of 14.72 had an ABG closure of 14 dB.⁸ Mehta et al also report a similar result of ABG

closure rates of >10 dB with a post-op mean ABG of 14 dB.²⁰ However, Gupta et al with a mean pre-op of 26.48 in their study group almost similar to ours, report a lesser post-operative result with mean post-operative ABG of 20.17 and closure of only 6.3 dB.⁶ Their post-op ABG across a wide 0-30 dB gap was only 82 % while we had 100% results in this range.

Comparing graft uptake between the approaches was not statistically significant in the transcanal group (100%) and postaural group (96%). While the graft uptake reported by various workers span a wide range depending on the procedures and experience of surgeons, Fadl et al reports a graft uptake of 94% with a better uptake in transcanal approach of 95.8% than postaural of 92.3% which was statistically significant.⁴ Mehta et al report a similar result as ours of 94%, while Singh et al, Raj and Meher have a result of 90%.^{8,20,21} Other workers report lesser uptakes with Shaikh et al, Yadav et al, Aich et al, Tawab and coworkers all reporting between 80-84 % graft uptakes only.^{10, 22-24} Sharma et al have compared the two approaches and found an only a slight difference between the two of no statistical significance with an overall success of 81.1%.⁹

Sismanis et al have opined that the results of tympanoplasty are measured in terms of success or failure of graft take and hearing improvement.¹⁸ Our results of the success of graft take and hearing improvement compare with that of Dornhoffer and Cueva though the sample size in their studies was much larger.^{25,26} There was no significant difference in success rates between transcanal and PA groups in our study. The post-aural approach is superior to a permeal approach by Sheehy and Anderson, (1980); and Shelton, (1985).²⁷ Al-Ghamdi (1994), Quraishi and Jones (1995), compared myringoplasty operation done by permeal approach with myringoplasty done via endaural or post-aural approach.^{28,29} The amount of suture material and their cost differences have also been discussed. When comparing the ease of access and adequacy of middle ear exposure by each approach, it depends much on familiarity and experience. Traditionally, the advantages of postaural approach are adequate exposure of surgical site and perforation through a single incision which can be extended for mastoid exploration if needed. All perforations irrespective of size or site can be accessed with this and easier placement of the graft. The disadvantages described are post-operative morbidity and complications being significantly higher, like the need for a mastoid bandage, bleeding during surgery, pain, haematoma, wound infection and dehiscence, wound healing time, persistent numbness at the incision site and granulations and granuloma formation in the Canal and keloid formation in the long run at the incision site.

Traditionally, as described by both Bluestone and Sismanis, transcanal approach has been said to be practical only for small central or posterior perforations and when the EAC is wide.^{3,30} However, sismanis goes

on to explain that postaural approach may be useful for surgeons with limited experience working through the ear canal. Here, the experience and training of the surgeon matters in that either approach will not make a difference to the experienced surgeon regarding access to the middle ear, nor ease of graft placement or width of the canal. This is expounded by Uguz et al and Fadl in their studies.^{4,31} As in our study, all cases were done by the same senior surgeon with experience, none of these parameters was different for the two approaches. The advantages of transcanal approach which we found irrefutable and unaffected by Surgeon's experience or training are following as:

- Straight and good view of the middle ear including ossicles and attic. It is a greater advantage than the distorted view from behind through a postaural approach.
- Negligible bleeding.
- Possibility of LA, lessening the total time factor for surgery.
- Lesser exposure to anaesthetic drugs, especially GA with their associated additional morbidity like haemodynamic instability need for rescue analgesia, postoperative discomfort and at times stormy recovery and more on-table bleeding. Newer drugs used for LA gave better analgesia, adequate sedation with no respiratory depression and no need for rescue analgesia.
- Total time for surgery and anaesthesia lesser, almost 1 ½ hour saved in OT time.
- Material costs lesser for closure, as well as POP morbidity and faster healing time.
- Lesser or no complications in our study as compared to significant complications in postaural approach.
- Better cosmetic results with a 2.5 cm healed scar disappearing within the hairline.
- The endoscope is a very versatile instrument in the hands of an otologist, being used transcanal with all the advantages mentioned above for diagnostic and therapeutic purposes, even to the inner ear.

These advantages of transcanal approach have been noted by other workers though there are very few studies on review of literature, who have compared the various approaches to the middle ear. Fadl agrees that "this approach merited the advantages of easier access to the middle ear, less bleeding, little scarring, time-saving and less subjected to infections".⁴ The disadvantages of working through a narrow canal, especially in cases with a canal overhang, could be overcome by training and experience and in the latter case, by canalplasty. Our findings suggested that the principle of Occam's razor when two approaches to the same surgery are available offering the same result the one which gives it at significantly lesser cost, significantly lesser time and offers a better quality of life to the patient should be adopted, in this case, the transcanal approach.³²

CONCLUSION

Tympanoplasty by postaural approach as compared to transcanal approach is more tedious, costlier, time consuming and affects the quality of life due to worse morbidity rates. In this era of day-care surgeries and higher costs of medical care, time equals money, with the additional burden of postoperative morbidity and complications that beset postaural approach entailing more hospital visits and hence expenses for the patient. This is in addition to the delay in getting back to Work and loss of income.

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