ENDOSCOPIC VERSUS MICROSCOPIC PROCEDURES FOR IDENTIFYING DIFFERENT MIDDLE EAR STRUCTURES IN PATIENTS WITH CHRONIC OTITIS MEDIA

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Abstract

Background: Microscopic surgery is the gold standard for surgeries of the middle ear, mastoid and lateral skull base. Endoscopic ear surgery is gaining increasing importance internationally as an adjunct to microsurgery and a further development of traditional microscopic ear surgery.

Aim of work: To compare the diagnostic performance of endoscopic and microscopic procedures in identifying the middle ear structures and associated diseases in patients with chronic otitis media.

Methods: Our prospective cohort study was carried out at Otorhinolaryngology and department, AL-Zahraa University Hospital, Al-Azhar University for girls from October 2020 to January 2023. We included fifty randomly selected patients with chronic otitis media, who were candidates for middle ear exploration or various types of tympanoplasty with or without a mastoidectomy, aged from 10 to 53 years old. All patients were subjected to pre-operative medical history and full otorhinolaryngologic examination. Otoscopic and /or microscopic examination were done for both ears after cleaning of the external ear from any discharge, if possible, to provide good examination and avoid radiological false results. We performed routine laboratory investigations, basic audiological evaluation (Pure tone audiometry, Tympanometry) and high-resolution CT (HRCT) of temporal bone without intravenous contrast.

Results: There was a statistically significant difference between microscopic and endoscopic visualization of epitympanum, stapes, long process of incus, incudostapedial joint, stapes, round window, eustachian tube and hypotympanum.

Conclusion: Endoscopic surgery has a clear advantage over microscopic surgery in extremely and unexpected detailed view of the "in vivo" anatomy of middle ear.

Key words: Endoscopy; Otitis; Media; Microscopy; Otorhinolaryngology.

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INTRODUCTION:

Minimally invasive otologic surgery has recently been developed along with endoscopic techniques. Endoscopically, the typical transcanal approach is possible by elevating a tympanomeatal flap. This avoids other unnecessary incisions and soft tissue dissections. The endoscopic approach also provides better visualization of hidden areas in the middle ear cavity including the anterior and posterior epitympanic spaces, sinus tympani, facial recess, and hypotympanum. In addition, the various segments of the mesotympanum, oval window, round window, and Eustachian tube were more visible via endoscopy (1). The value of endoscopes combined with the conventional microscopic eradication of cholesteatoma has been well established. Besides surgeries for cholesteatoma removal, an exclusively endoscopic approach during tympanoplasty has been applied to facilitate minimally invasive surgery (2).

However, endoscopic surgery has several disadvantages. One-hand surgery is feasible with the endoscopic technique, which is less efficient; in a situation of massive bleeding, the endoscopic view could be stained by blood and continuing the procedure could be difficult. Furthermore, endoscopic instruments could cause direct injury and thermal damage by light source (3). Some studies have reported successful surgeries of the middle ear including myringoplasty, surgery of the retraction pocket, stapedotomy, and removal of dermoid tumors of the Eustachian tubes using the endoscopic approach. Because of some potential limitations of the endoscopic procedure including

iatrogenic trauma, induced hyperthermia, and one-handed application, the use of this procedure is relatively uncommon in clinical settings (4).

AIM OF WORK:

To compare the diagnostic performance of endoscopic and microscopic procedures in identifying the middle ear structures and associated diseases in patients with chronic otitis media.

METHODS:

Our prospective cohort study was carried out at Otorhinolaryngology and department, AL-Zahraa University Hospital, Al-Azhar University for girls from October 2020 to January 2023. The study was approved by the Research Ethics Committee of faculty of medicine for girls, AL- Azhar University. An informed consent was taken from each patient/his parents involved in the research prior to his/her participation. We included fifty randomly selected patients with chronic otitis media, who were candidates for middle ear exploration or various types of tympanoplasty with or without a mastoidectomy, aged from 10 to 53 years old. We excluded cases of acute suppurative otitis media, less than 10 years old, refused to participate in the study, with any uncontrolled systemic diseases or pregnancy or on medications affecting wound healing or contraindicated for surgery or who were candidates for second-stage hearing reconstruction or revision tympanoplasty with or without a mastoidectomy. All patients were subjected to pre-operative medical history and full otorhinolaryngologic examination. Otoscopic and /or microscopic examination were done for both ears after cleaning of the external ear from any discharge, if possible, to provide good examination and avoid radiological false results. We performed routine laboratory investigations including complete blood count, liver and kidney function tests, serum blood glucose level and coagulation profile. Basic audiological evaluation was also done (Pure tone audiometry, Tympanometry). High resolution CT (HRCT) of temporal bone was done without intravenous contrast axial and coronal views from the level of superior border of petrous temporal bone till the level of mastoid tip mainly in cholesteatoma cases. Images were obtained in 3-mm thickness.

Under general anesthesia, and before the surgical intervention, the middle ear was examined with an operating microscope(Leica M525 F40 surgical microscope) in different positions and the visible anatomical areas were evaluated and recorded by performing gentle maneuvers on the patient`s head. Middle ear pathologies were explored with the identical technique, and the ossicles were assessed as well. The middle ear was evaluated using rigid endoscope (a zero and 30-degree rigid endoscope (Karl Storz Image 1 HD H3 3-chip Camera Head and Diameter 4 mm, Work Length 18 cm, Karl Storz Image lens, Germany figure 34), and all of the components of the middle ear were assessed. The evaluations of the middle ear required approximately five minutes for each patient. Conventional middle ear surgery, using a microscope, was performed, and before the end of surgery, the ear was reevaluated by endoscopy to detect any remaining disease. The exact anatomical sites were recorded, and a specimen was obtained for further pathological assessment, if any remaining disease were detected.

STATISTICS/DATA ANALYSIS:

Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Paired sample t-test of significance was used when comparing between related sample. The Chi-square (X2) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant <0.05, highly significant <0.001, insignificant >0.05.

RESULTS:

This study included 50 randomly selected patients, their age was ranging from 10-53 with mean (25.44 ± 10.01), 30 (60.0%) were female and 20 (40.0%) were males all free from medical diseases. Surgery was performed on the right ear in 10 cases (20.0%) and left ear 40 cases (80.0%) (Table 1). Regarding types and examination, unsafe types were found in 8 cases (16%) in which pre-operative examination revealed marginal perforation in 4 cases(8.0%) and attic perforation in 4 cases (8.0%). The operation was done via post-auricular approach in 8 (16.0%) and mastoidectomy was done in in 8 ears (16.0%); as canal wall up in 6 cases and atticotomy in 2 cases (Table 2). Safe types of chronic ear perforation were found in 42 cases (84%), On examination aural polyp found in 2 cases (4.0%), small central perforation in 8 cases (16.0%), medium central perforation in 14 cases (28.0%) and large central perforation in 18 (36.0%). Surgery was done via post-auricular approach in 4 cases (8.0%), transcanal in 38 cases (76.0%). Mastoidectomy was done in 2 cases (4.0%) and not done in the rest 40 cases (80.0%) of safe type cases (Table 3). As regards microscopic and endoscopic visualization of epitympanum (p value 0.001), endoscopic examination was done mainly by angled endoscope (30° degree). In this study there was a statistically significant difference between them (Table 4). Regarding ossicular visualization, there was statistically significant difference between

microscopic and endoscopic visualization of stapes (p value 0.014), long process of incus (p value 0.013), incudostapedial joint (p value 0.019) and stapes suprastructure (p value 0.014) with no statistically significant difference between microscopic and endoscopic visualization of malleus (Table 5). As regard visualization of round window, there was statistically significant difference between microscopic and endoscopic visualization (p value 0.025), no statistically significant difference between microscopic and endoscopic visualization of oval window area (Table 6). Regarding visualization of eustachian tube, there was highly statistically significant difference between microscopic and endoscopic view (p value 0.001), highly statistically significant difference between microscopic and endoscopic visualization of hypotympanum (p value 0.001). No statistically significant difference between microscopic and endoscopic visualization of promontory and facial nerve (Table 7, 8).

Tables:

Table (1): Demographic data including age, gender, and side of surgery:

		No. = 50
Age	Mean ± SD Range	25.44 ± 10.01 10 – 53
Sex	Female Male	30 (60.0%) 20 (40.0%)
Operated ear	Right Left	10 (20.0%) 40 (80.0%)

Table (2): Unsafe type:

		No. = 50
Safe/Unsafe	Unsafe(Squamosal)	8 (16.0%)
Examination	Marginal perforation Attic perforation	4 (8.0%) 4 (8.0%)
Approach	Post-auricular	8 (16.0%)
Mastoidectomy	Yes	8 (16.0%)

Table (3): Safe type:

		No. = 50
Safe/Unsafe	Safe(Mucosal)	42 (84.0%)
Exam	Aural polyp Small central perforation Medium central perforation Large central perforation	2 (4.0%) 8 (16.0%) 14 (28.0%) 18 (36.0%)
Approach	Post-auricular Transcanal	4 (8.0%) 38 (76.0%)
Mastoidectomy	No Yes	40 (80.0%) 2 (4.0%)

Table (4): Visualization of epitympanum of middle ear using microscope and endoscopes:

Epitympanum	**Endoscopic**		**Microscopic**		**Test value***	**P-value**	**Sig.**
	No.	**%**	**No.**	**%**			
Not visualized	4	8.0%	22	44.0%	18.942	0.001	HS
Partially visualized	34	68.0%	16	32.0%			
Full visualized	12	24.0%	12	24.0%			

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)

*:Chi-square test

Table (5): Visualization ossicles using microscope and endoscopes:

		Endoscopic		Microscopic		Test value*	P-value	Sig.
		No.	%	No.	%			
Malleus	Not visualized	0	0.0%	0	0.0%	0.000	1.000	NS
	Partially visualized	6	12.0%	6	12.0%			
	Full visualized	44	88.0%	44	88.0%			
Incus	Not visualized	0	0.0%	8	16.0%	8.730	0.013	S
	Partially visualized	30	60.0%	26	52.0%			
	Full visualized	20	40.0%	16	32.0%			
Stapes	Not visualized	16	32.0%	30	60.0%	8.483	0.014	S
	Partially visualized	24	48.0%	12	24.0%			
	Full visualized	10	20.0%	8	16.0%			
Incudo stapedial joint	Not visualized	6	12.0%	18	36.0%	7.916	0.019	S
	Partially visualized	24	48.0%	18	36.0%			
	Full visualized	20	40.0%	14	28.0%			
stapes suprastructure	Not visualized	16	32.0%	30	60.0%	8.483	0.014	S
	Partially visualized	24	48.0%	12	24.0%			
	Full visualized	10	20.0%	8	16.0%			

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test

Table (6): Visualization of medial wall of middle ear (round and oval window area) using microscope and endoscopes:

		Endoscopic		Microscopic		Test value	P-value	Sig.
		No.	%	No.	%			
Oval window	Not visualized	34	68.0%	36	72.0%	0.279	0.870	NS
	Partially visualized	6	12.0%	6	12.0%			
	Full visualized	10	20.0%	8	16.0%			
Round window	Not visualized	4	8.0%	14	28.0%	7.403	0.025	S
	Partially visualized	38	76.0%	32	64.0%			
	Full visualized	8	16.0%	4	8.0%			

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test

Table (7): Visualization of promontory, eustachian tube and facial nerve using microscope and endoscopes:

		Endoscopic		Microscopic		Test value	P-value	Sig.
		No.	%	No.	%			
Promontory	Not visualized	0	0.0%	0	0.0%	NA	NA	NA
	Partially visualized	0	0.0%	0	0.0%			
	Full visualized	50	100.0%	50	100.0%			
Eustachian tube	Not visualized	6	12.0%	24	48.0%	16.679	0.001	HS
	Partially visualized	28	56.0%	20	40.0%			
	Full visualized	16	32.0%	6	12.0%			
Facial nerve	Not visualized	38	76.0%	42	84.0%	2.200	0.333	NS
	Partially visualized	6	12.0%	6	12.0%			
	Full visualized	6	12.0%	2	4.0%			

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P value< 0.01: highly significant (HS) *:Chi-square test

Table (8):Visualization of blind niches (facial recess, sinus tympani& hypotympanum) using microscope and endoscope:

		Endoscopic		Microscopic		Test value*	P-value	Sig.
		No.	%	No.	%			
Facial recess	Not visualized	44	88.0%	48	96.0%	4.174	0.124	NS
	Partially visualized	2	4.0%	2	4.0%			
	Full visualized	4	8.0%	0	0.0%			
Sinus tympani	Not visualized	34	68.0%	42	84.0%	7.064	0.029	S
	Partially visualized	10	20.0%	8	16.0%			
	Full visualized	6	12.0%	0	0.0%			
Hypotympanum	Not visualized	8	16.0%	30	60.0%	27.864	0.001	HS
	Partially visualized	22	44.0%	18	36.0%			
	Full visualized	20	40.0%	2	4.0%			

P-value >0.05: Non-significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test

DISCUSSION:

Microscopic surgery is the gold standard for surgeries of the middle ear, mastoid and lateral skull base. Endoscopic ear surgery is gaining increasing importance internationally as an adjunct to microsurgery and a further development of traditional microscopic ear surgery. Subsequent publications describe two types of endoscopic ear surgery: a secondary endoscopic approach(using the endoscope for an additional visual control in microscopic middle ear surgery) and primary endoscopic ear surgery, i.e., all steps of surgery are performed endoscopically (5).

The aim of this study is to compare the diagnostic performance of endoscopic and microscopic procedures in identifying the middle ear structures and associated diseases in patients with chronic otitis media. These approaches identify the pathological or structural abnormalities in different parts of the middle ear. Although several studies have assessed the diagnostic accuracy of microscopic and endoscopic procedures separately, this study includes comparison of the visibility of the two approaches. In this study there was a statistically significant difference between microscopic and endoscopic visualization of epitympanum (p value 0.001). Endoscopic examination was done mainly by angled endoscope (30° degree). This Agree with Karchier et al., who found that Prussak's space was difficult to control in the operating microscope, was well visualized by endoscope (6). Farahani et al., also agree with our study as they found that the epitympanum and posterior mesotympanum structures as well as most parts of the mesotympanum were significantly more visible through the endoscope than through the microscope (4).

In this study there was statistically significant difference between microscopic and endoscopic visualization of stapes, long process of incus, incudo-stapedial joint and stapes suprastructure with no statistically significant difference between microscopic and endoscopic visualization of malleus. In Kaushal study, the examination of ossicles in their study revealed that while there is no added benefit by otoendoscopy in assessing the malleus over the microscope but there is a definite benefit of endoscope in visualizing the incus (7). In visualizing the incudostapedial joint the angled otoendoscope has a definite advantage over microscope due to the angled view. Ghaffar et al., in their study complete visualization of the ossicles was achieved in (82.9%) in microscopic group compared to full visualization in endoscopic group and that agree with our study (8). In our study there was a statistically significant difference between microscopic and endoscopic visualization of round window. Our results were supported by Menon et al.

found the round window niche was better visualized with the wider angle of the 30-degree endoscope (9). In our study there was no statistically significant difference between microscopic and endoscopic visualization of oval window area, yet better visualization recorded by endoscope, that agree with Farahani et al. (4). Versus our study, Menon et al. found that fully visualized oval window area was highly significant, and it could be interpreted by use of both the 30o and 70o endoscopes (9) and Ghaffar et al. conducted a study entitled 'Incorporating the endoscope into middle ear surgery' and found that a 30° endoscope can visualize the middle ear in almost all cases (8). There was a high statistically significant difference between microscopic and endoscopic visualization of eustachian tube. This agrees with Kumar et al., as in their study of 50 cases (64 ears), found that 30° 2.7 mm endoscope provided valuable information especially regarding the eustachian tube orifice (10). Visualization of eustachian tube opening and hypotympanum mainly by both 30- and 70-degree endoscopy showed in Goel et al., and Behiery et al., had described that the tympanic orifice of the tube can be seen better with a 70-degree endoscope, and they support our study (11, 12). There was no statistically significant difference between microscopic and endoscopic visualization of promontory and facial nerve, and this agree with Farahani et al. (4). There is highly statistically significant difference between microscopic and endoscopic visualization of hypotympanum and that agree with Kumar et al., and Kaushal, who studied 62 patients in his research and found that hypotympanum was visualized in only 16 (25.8%) cases by microscope, whereas in 58 (93.5%) cases it was visualized by the otoendoscope (10, 7). There is a statistically significant difference between microscopic and endoscopic visualization of sinus tympani. This agrees with Showkat et al., and Farahani et al. (13). There is no statistically significant difference between microscopic and endoscopic visualization of facial recess, yet better visualization. Menon et al. agreed with our study as the sinus tympani was not visualized with either the microscope or 0-degree endoscope (9). Showkat et al. disagree with us as they had found statistical significance difference was present as they previously observed that the facial recess is best viewed with a 70-degree endoscope (13). Yet, we used the zero- or 30-degree endoscope with the microscope.

Conclusion and recommendations:

Endoscopic surgery has a clear advantage over microscopic surgery in extremely and unexpected detailed view of the "in vivo" anatomy of middle ear. Exploration of hidden recesses like the sinus tympani and other retrotympanic structures, and the protympanic space with such a magnification is difficult with microscopic traditional approaches as in cases in which visibility by microscopy is disturbed and the surgeon suspects that pathologies remain in the middle ear, endoscopy could be utilized efficiently to improve the visibility and assessment of additional hidden middle ear spaces and structures, particularly if there were a potentially recurrent pathology. The improved image clarity and illumination offered by the endoscope, with the possibility to "look around the corner", encouraged visualization and magnification of anatomy and its minimal invasivity. Also, preservation of a large amount of healthy mastoid tissues and functional mucosa. Our study recommended the use of endoscopes especially for hidden middle ear pits and structures.

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