

## Original Research Article

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# Role of otoendoscope as a preoperative tool in tympanoplasty

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## ABSTRACT

**Background:** Chronic suppurative otitis media (CSOM) is one of the common causes for hearing impairment and disability. Despite continuous technical improvement, the basic optical principles and their limitations have remained the same over the past three decades. This study aimed at visualizing and evaluating the middle ear structures with the aid of 0 and 30-degree otoendoscopes preoperatively in cases of chronic suppurative otitis media.

**Methods:** In this prospective study, 70 patients (40 females and 30 males) above the age of 10 years with CSOM were subjected to otoendoscopy using 0- and 30-degree endoscopes. The various middle ear structures and hidden spaces like facial recess, sinus tympani, hypotympanum were visualized preoperatively.

**Results:** Middle ear structures and blind niches were better evaluated preoperatively using 0 and 30-degree otoendoscopes and a definitive operative plan was formulated.

**Conclusions:** Otoendoscopy provided a significant better visualization of all the middle ear structures and various hidden spaces.

**Keywords:** Otoendoscopes, Chronic suppurative otitis media, Middle ear structures

## INTRODUCTION

Chronic suppurative otitis media is one of the common causes of hearing impairment and disability. The tympanic membrane is the window to the middle ear, but merely observing it with the naked eye is not sufficient for accurately diagnosing the pathology. The otologist has a large range of technological support at their disposal, such as the otologic microscope and otoendoscope, to visualize and document the pathologies of the middle ear, these being essential for surgical intervention. Visual inspection supported by anamnestic information is the primary element in correctly formulating a diagnosis in otology.<sup>1</sup> Despite continuous technical improvements, the basic optical principles and their limitations have remained the same over the past three decades.<sup>2</sup>

In addition to microscopic techniques, the application of

flexible and rigid endoscopes has become usual for clinical evaluation of the structures of the middle ear. High-resolution fibers passed through the nasal cavity have been used to inspect the lumen of the Eustachian tube, sometimes being passed all the way into the middle ear cavity.<sup>3-5</sup>

A rigid endoscope can be employed to visualize and evaluate the extent of middle ear disease, assess ossicular integrity and explore the hidden niches of the middle ear, i.e., sinus tympani, facial recess, attic, hypotympanum, protympanum, Eustachian tube, sinus tympani and ponticulus, etc.

Despite its advantages otoendoscope has few disadvantages which include lack of binocular vision and depth perception as compared to operating microscope. Furthermore, there is a distortion factor while using an otoendoscope.

The aim of our study was to evaluate the usefulness of otoendoscope for diagnosis and planning middle ear surgeries so that the use of otoendoscopes in the outpatient setup is routinely used to correctly diagnose the middle ear pathologies and to formulate the proper surgical plan.

## METHODS

The prospective study was conducted in the postgraduate department of otorhinolaryngology and head and neck surgery, government medical college, Srinagar from September 2016 to March 2018. All the patients who were diagnosed as CSOM with conductive hearing loss and in whom tympanoplasty was planned were included in the study.

### Inclusion criteria

Patients with perforations of tympanic membrane. Patients aged between >10 years and <60 years. Patients whose middle ear was found dry for at least 6 weeks.

### Exclusion criteria

Patients below 10 years of age and above 60 years of age. Patients with active ear discharge or otitis externa. Patients with mixed or sensorineural hearing loss.

Preoperative endoscopic assessment of the middle ear was performed using 0 and 30-degree otoendoscopes and findings of otoscopic examination were confirmed or

modified. After preoperative otoendoscopic assessment patients were subjected to microscopic examination before and after elevating the tympanomeatal flap.

The findings of preoperative otoendoscopic examination were confirmed or modified, the operative plan for the patient was formulated and the procedure was completed using microscope. Data was entered in excel sheet and analysis was done using SPSS v23 and expressed as percentage.

## RESULTS

Structures visualized using 0° otoendoscope included handle of malleus and incudostapedial joint area in 70 (100%) patients each. Long process of incus was visualized in 67 (95.7%), stapes suprastructure in 52 (74.2%) and stapedius tendon in 48 (68.5%) patients. In medial wall, oval and round window was completely visualized in 50 (71.4%) patients. Blind niches, which included facial recess, sinus tympani and hypotympanum were completely visualized in 45 (64.2%) patients.

Structures visualized using 30° otoendoscope included handle of malleus, Incudostapedial joint area, long process of incus, stapes suprastructure and stapedius tendon in 70 (100.0%) patients each. In medial wall, oval and round window were completely visualized in 68 (97.1%) patients. Blind niches, which included facial recess, sinus tympani and hypotympanum were completely visualized in 69 (98.5%) patients.

**Table 1: Otoendoscopic examination of middle ear.**

Findings			0 degree (%)	30 degree (%)
<b>Ossicular status</b>		Handle of malleus	70 (100)	70 (100)
		Incudostapedial joint area	70 (100)	70 (100)
		Long process of incus	67 (95.7)	70 (100)
		Stapes superstructure	52 (74.2)	70 (100)
		Stapedius tendon	48 (68.5)	70 (100)
<b>Medial wall</b>	Oval window	Not visualized	0 (0)	0 (0)
		Partially visualized	20 (28.5)	2 (2.85)
		Completely visualized	50 (71.4)	68 (97.1)
	Round window	Not visualized	0 (0)	0 (0)
		Partially visualized	20 (28.5)	2 (2.85)
		Completely visualized	50 (71.4)	68 (97.1)
<b>Blind Niches</b>	Facial recess	Not visualized	0 (0.0)	0
		Partially visualized	25 (35.7)	1 (1.42)
		Completely visualized	45 (64.2)	69 (98.5)
	Sinus tympani	Not visualized	0 (0)	0
		Partially visualized	25 (35.7)	1 (1.42)
		Completely visualized	45 (64.2)	69 (98.5)
	Hypo-tympanum	Not visualized	0 (0)	0
		Partially visualized	25 (35.7)	1 (1.42)
		Completely visualized	45 (64.2)	69 (98.5)

**Table 2: Microscopic examination of middle ear (before elevating tympanomeatal flap).**

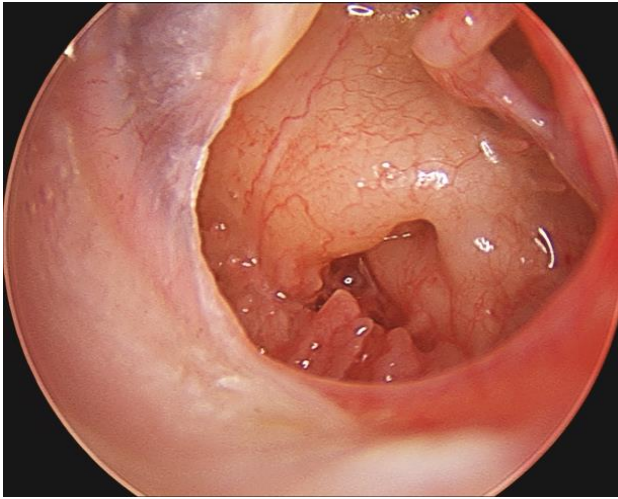
Findings		No. of patients	Percentage (%)	
Ossicular status	Handle of malleus	65	92.8	
	Incudostapedial joint area	51	72.86	
	Long process of incus	51	72.8	
	Stapes superstructure	25	35.71	
	Stapedius tendon	25	35.71	
Medial wall	Oval window	Not visualized	45	64.28
		Partially visualized	10	14.28
		Completely visualized	15	21.43
	Round window	Not visualized	45	64.28
		Partially visualized	10	14.28
		Completely visualized	15	21.43
Blind niches	Facial recess	Not visualized	66	94.28
		Partially visualized	4	5.71
		Completely visualized	0	0
	Sinus-tympani	Not visualized	66	94.28
		Partially visualized	4	5.71
		Completely visualized	0	0
	Hypo-tympanum	Not visualized	66	94.28
		Partially visualized	4	5.71
		Completely visualized	0	0

**Table 3: Intraoperative microscopic findings.**

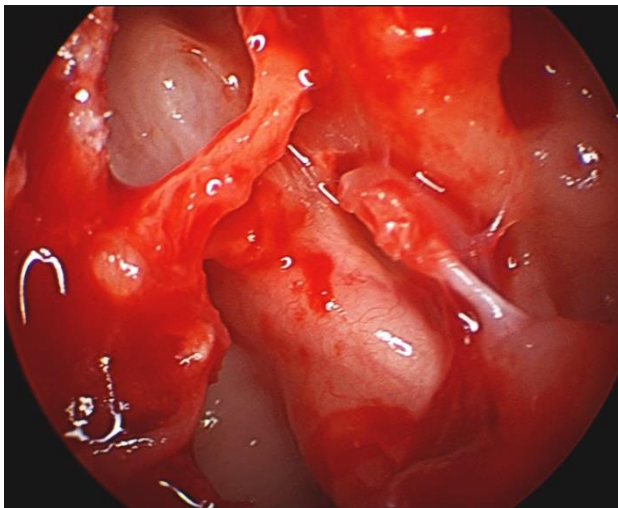
Findings		No. of patients	Percentage (%)
Ossicular status	Handle of malleus	70	100
	Incudostapedial joint area	70	100
	Long process of incus	70	100
	Stapes superstructure	70	100
	Stapedius tendon	69	98.57
Medial wall	Oval window	Not visualized	0
		Partially visualized	12
		Completely visualized	58
	Round window	Not visualized	0
		Partially visualized	12
		Completely visualized	58
Blind niches	Facial recess	Not visualized	0
		Partially visualized	17
		Completely visualized	53
	Sinus-tympani	Not visualized	0
		Partially visualized	17
		Completely visualized	53
	Hypo-tympanum	Not visualized	0
		Partially visualized	17
		Completely visualized	53

Structures that were visualized during microscopic examination of the middle ear (before elevating the tympanomeatal flap) included handle of malleus in 65 (92.8%), incudostapedial joint area in 51 (72.86%), long process of incus in 51 (72.86%), stapes suprastructure and stapedius tendon in 25 (35.71%) patients each. In

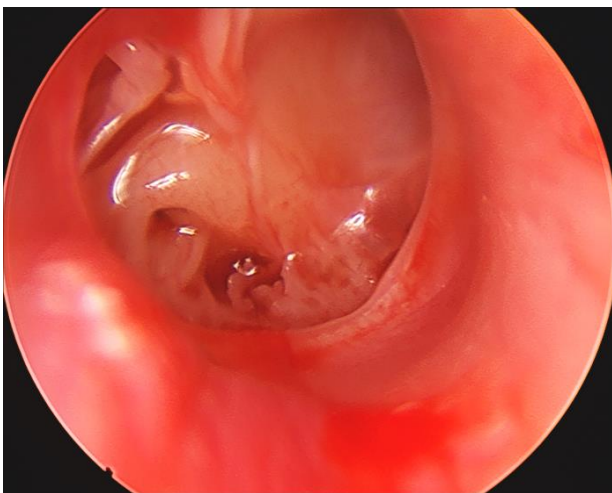
medial wall, oval and round window was not visualized in 45 (64.28%) patients, partially visualized in 10 (14.28%) and completely visualized in 15 (21.43%) patients. In blind niches, facial recess, sinus tympani and hypotympanum were not visualized in 66 (94.28%) and partially visualized in 4 (5.71%) patients.



**Figure 1: Otoendoscopic view of middle ear (L) before elevating tympanomeatal flap.**

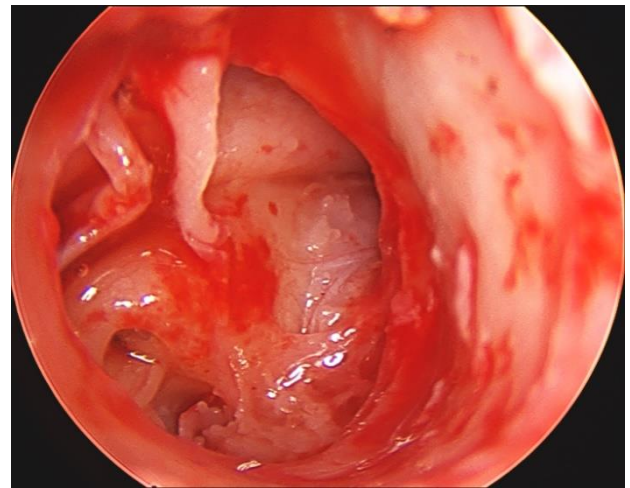


**Figure 2: Otoendoscopic view of middle ear (L) after elevating tympanomeatal flap.**



**Figure 3: Otoendoscopic view of middle ear (R) before elevating tympanomeatal flap.**

Intraoperative microscopic findings included visualization of handle of malleus and incudostapedial joint area in 70 (100%) patients each. Incudostapedial joint was seen dislocated in 5 patients. Long process of incus was visualized in 70 (100.0%) cases and was seen necrosed in 14 (20%) cases. Stapes suprastructure was visualized in 70 (100.0%) and stapedius tendon in 69 (98.57%) cases. In medial wall oval and round window was partially visualized in 12 (17.14%) and completely visualized in 58 (82.85%) patients. In blind niches facial recess, sinus tympani and hypotympanum were partially visualized in 17 (24.28%) patients and completely visualized in 53 (75.72%) patients.



**Figure 4: Otoendoscopic view of middle ear (R) after elevating tympanomeatal flap.**

## DISCUSSION

In our study the structures visualized by using 0° otoendoscope included handle of malleus and incudostapedial joint area in 70 (100%) patients each. Long process of incus was visualized in 67 (95.7%), stapes suprastructure in 52 (74.2%) and stapedius tendon in 48 (68.5%) patients. In medial wall, oval and round window was completely visualized in 50 (71.4%) patients. Blind niches, which included facial recess, sinus tympani and hypotympanum were completely visualized in 45 (64.2%) patients. The structures that were visualized using 30° otoendoscope included handle of malleus, Incudostapedial joint area, long process of incus, stapes suprastructure and stapedius tendon in 70 (100.0%) patients each. In medial wall, oval and round window were completely visualized in 68 (97.1%) patients. Blind niches, which included facial recess, sinus tympani and hypotympanum were completely visualized in 69 (98.5%) patients. Kumar et al in their study of 50 cases (64 ears), found that 30° 2.7 mm endoscope provided valuable information especially regarding the eustachian tube orifice, the protympanum and hypotympanum.<sup>6</sup> Kaushal et al studied 62 patients in his research dissertation 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.<sup>7</sup> Hence there is a statistically significant benefit with otoendoscope in assessing middle ear mucosa, the eustachian tube, protympanum and hypotympanum. The examination of ossicles in their study revealed that while there is no added benefit by otoendoscopy in assessing the malleus over the microscope (p value >0.05) there is a definite benefit of otoendoscope in visualizing the incus. In visualizing the incudostapedial joint the angled otoendoscope has a definite advantage over microscope due to the angled view. This was also demonstrated in their study that in 50 cases (80.6%) out of the 62 cases, the Incudostapedial joint could be visualized using the otoendoscope while only in 9 (14.5%) cases the Incudostapedial joint could be visualized by microscope.

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.<sup>2</sup> During endoscopy, the malleus, incus, and stapes can be visualized and palpated. The hidden structures of the middle ear - the sinus tympani, facial recess, attic, and hypotympanum - can also be easily visualized. They concluded that the advantages of otoendoscopy was that it provided a wide-angle view of the entire tympanic ring and ear canal at the same time without the need for repeatedly repositioning the patient. Another important advantage was that it could visualize structures parallel to its axis; this was not possible with a microscope, the use of which required the structures to be at a right angle to the axis for adequate visualization. Majority of the middle ear structures that were visualized during microscopic examination of the middle ear (before elevating the tympanomeatal flap) included handle of malleus in 65 (92.8%), incudostapedial joint area in 51 (72.86%), long process of incus in 51 (72.86%), stapes suprastructure and stapedius tendon in 25 (35.71%) patients each. In medial wall, oval and round window was not visualized in 45 (64.28%) patients, partially visualized in 10 (14.28%) and completely visualized in 15 (21.43%) patients. In blind niches, facial recess, sinus tympani and hypotympanum were not visualized in 66 (94.28%) and partially visualized in 4 (5.71%) patients.

Thus, otoendoscopic examination was superior to examination under microscope in visualization of middle ear structures especially oval window area and blind niches (facial recess, sinus tympani and hypotympanum).

In majority of the cases post endoscopic operative plan formulated was Type 1 tympanoplasty in 42 cases (60% of the study population), followed by type 2 tympanoplasty in 19 cases (27.14% of the study population) and tympanoplasty with atticotomy in 9 cases (12.86% of the study population).

In our study, intraoperative microscopic findings included visualization of handle of malleus and incudostapedial joint area in 70 (100%) patients each.

Incudostapedial joint was seen dislocated in 5 patients. Long process of incus was visualized in 70 (100.0%) cases and was seen necrosed in 14 (20%) cases. Stapes suprastructure was visualized in 70 (100.0%) and stapedius tendon in 69 (98.57%) cases. In medial wall oval and round window was partially visualized in 12 (17.14%) and completely visualized in 58 (82.85%) patients. In blind niches facial recess, sinus tympani and hypotympanum were partially visualized in 17 (24.28%) patients and completely visualized in 53 (75.72%) patients.

Farahani et al studied 58 patients with chronic COM who were candidates for tympanoplasty with or without a mastoidectomy.<sup>8</sup> Their microscopic and endoscopic findings included visualization of malleus in 47 (81%) patients by each method, incus which was visualized in 39 (67.2%) patients by microscope and in 40 (69.0%) patients by endoscopic examination. Stapes was visualized through microscope in 38 (65.5%) patients and through endoscope in 47 (81.0%) patients. Oval window was visualized through microscope and endoscope in 33 (56.9%) and 46 (79.3%) patients, respectively. Round window was visualized through microscope in 39 (67.2%) and through endoscope in 52 (89.7%) patients. Sinus tympani was visualized through microscope and endoscope in 3 (5.2%) and 23 (39.7%) patients respectively and hypotympanum in 14 (24.1%) and 32 (55.1%) patients respectively.

## CONCLUSION

In our study after intraoperative microscopic examination, the findings of otoendoscopic examination matched closely in terms of ossicular chain status and visualization of hidden areas. The operative procedure executed finally matched with the preoperative otoendoscopic operative plan in 100% of patients i.e. 42 patients underwent type 1 TP, 19 patients underwent type 2 TP and 9 patients underwent TP with atticotomy. Thus, otoendoscopic examination could predict the operative plan well in advance in all the patients without facing any surprises intraoperatively. This was the greatest advantage of the use of otoendoscopic examination preoperatively in our study population who finally underwent the procedure as per the preoperative plan.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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