



E-ISSN: 2706-9575
P-ISSN: 2706-9567
IJARM 2020; 2(2): 57-62
Received: 02-12-2020
Accepted: 15-12-2020

Dr. Mohammed Kareemullah Khan
Assistant Professor,
Department of ENT, Dr. VRK
Womens Medical College, Aziz
Nagar, Ranagareddy,
Telangana, India

A study of surgical management of cholesteatoma and its outcome

Dr. Mohammed Kareemullah Khan

Abstract

Background: Cholesteatoma has long been a formidable adversary to the otologic surgeon. There is no single surgical treatment of choice for aural cholesteatoma. Hence it was important to determine the surgical outcomes of cholesteatoma in a country where the prevalence of the disease still remains high.

Objectives

1. To determine the incidence of residual & recurrent cholesteatoma with various surgical procedures.
2. Evaluation of hearing status at post-operative stage with various surgical procedures.
3. To determine the incidence of post-operative complications such as perichondritis, external auditory canal stenosis, wound dehiscence, facial nerve palsy, and sensorineural hearing loss.

Methods: Prospective study on 50 patients who underwent surgery for cholesteatoma.

Results: Cholesteatoma occurs more commonly in children with otorrhea as the most common presenting symptom. The residual disease rate for ICW mastoidectomy was determined as 12% whereas recurrence rate was nil. CWD mastoidectomy had no residual or recurrent disease in the 6 month follow-up period, but to note is that 5 of the 6 patients who underwent revision surgery for recurrent cholesteatoma had previous CWD mastoidectomy. The net improvement in ABG in ICW mastoidectomy was 16.03(\pm 7.5) dB and that in CWD mastoidectomy was 11.39(\pm 7.4) dB with a significant p value of 0.04 as determined by the independent 't' test.

Conclusion: The literature supports the use of both ICW and CWD techniques. Eradication of cholesteatoma has always been the priority, but with advance in the surgical techniques hearing improvement and quality of life issues need to be addressed. With this in the background, ICW mastoidectomy is the preferred choice in our study. However owing to the high incidence of residual disease it is important for the surgeon to counsel the patients regarding the probable need for multiple surgeries. Further studies with long-term follow-up is recommended.

Keywords: Cholesteatoma, ICW, CWD, residivism, hearing outcome

Introduction

Cholesteatoma is an erosive process causing destruction of the middle ear structures, leading to hearing impairment in a large majority of patients affected. The expansion of cholesteatoma may result in bone erosion of the ossicles, otic capsule, fallopian canal, tegmen tympani, and tegmen mastoideum^[1]. The involvement of these structures that are in close proximity to the middle ear can cause irreversible sequelae and life-threatening complications. Papillary cholesteatoma represents the presence of nonneoplastic accumulation of keratinizing stratified squamous epithelium along with desquamated keratin debris in the tympanic cavity and/or mastoid. Once the squamous epithelium reaches these areas from its origin in the external auditory canal or tympanic membrane, a locally invasive and destructive process typically ensues. The rate of progression of the disease is usually insidious. Surgery is the treatment. The goals of surgical management include the eradication of disease, restoration of hearing, and to the extent possible, maintenance or restoration of normal anatomic configuration. There is no single surgical treatment of choice for aural cholesteatoma. The extent of cholesteatoma, the amount of preoperative destruction, mastoid pneumatization guide the surgeon in choosing the type of operation for a particular ear-which may range from simple extraction of Cholesteatoma to radical mastoidectomy^[1]. Chronic Otitis Media with cholesteatoma is a major cause of morbidity including dangerous intratemporal and intracranial complications. In India the incidence of COM with cholesteatoma and complications are still very high.

Corresponding Author:
Dr. Mohammed Kareemullah Khan
Assistant Professor,
Department of ENT, Dr. VRK
Womens Medical College, Aziz
Nagar, Ranagareddy,
Telangana, India

Because cholesteatomas contain keratin debris enclosed in a tissue space, they are subject to recurrent infection¹, often causing foul-smelling discharge affecting the quality of life for these patients. Cholesteatoma whether congenital or acquired, can only be eradicated from the temporal bone by surgical resection. The goals of surgical management include the eradication of disease, restoration of hearing, and to the extent possible, maintenance or restoration of normal anatomic configuration [2-4]. Cholesteatoma has long been a formidable adversary to the otologic surgeon. There is no single surgical treatment of choice for aural cholesteatoma. The extent of cholesteatoma, the amount of preoperative destruction, mastoid pneumatization guides the surgeon in choosing the type of operation for a particular ear - which may range from simple extraction of cholesteatoma to radical mastoidectomy [4]. Owing to the risks of severe complications, COM with cholesteatoma dictates immediate surgical intervention. Also there is a high prevalence of the disease in India with limited studies comparing the surgical management and its outcome. Hence it was important to determine the surgical outcomes of COM with cholesteatoma in a country where the prevalence of the disease still remains high.

Aim and Objectives

1. To determine the incidence of residual & recurrent cholesteatoma with various surgical procedures.
2. Evaluation of hearing status at post-operative stage with various surgical procedures.
3. To determine the incidence of post-operative complications such as perichondritis, external auditory canal stenosis, wound dehiscence, facial nerve palsy, and sensorineural hearing loss.

Source of data

The patients attending the department of ENT and also patients referred from other departments of combined hospitals of Dr. VRK Womens Medical College formed the subjects for our study.

Inclusion Criteria

1. All patients of chronic otitis media with cholesteatoma
2. Patients with recurrent or residual cholesteatoma (previously operated cases)

Exclusion Criteria

1. All patients with chronic otitis media safe type (without cholesteatoma)
2. Patients with minimal retraction pockets, Tympanosclerosis, Adhesive otitis media

Method of collection of data

A written informed consent was taken from all patients included in the study. Detailed history-taking, thorough clinical examination was done for these patients. The data collected was entered into a specially designed case record form.

Duration of study

The study was conducted from December 2018 to August 2019 and patients were followed-up for period of 6months. Follow-up at 1, 3 and 6 months was done.

Sample size

This study comprised of 42 patients who were admitted and who underwent surgical management in the Department of ENT, Dr VRK Womens Medical College, Hyderabad.

Preoperative tests and evaluation

All the 42 patients who underwent surgical management for cholesteatoma in this study were, in their own language, explained in detail about the nature of the disease, the anesthetic procedure, the operative procedure and possible complications and consent was obtained from them.

In all the patients thorough examination, routine investigations, relevant audiological and radiological tests were performed. Relevant investigations among the following were performed:

- Hematological – complete blood count
- Biochemical– blood sugar, blood urea, serum creatinine
- Otoscopy
- Otomicroscopy
- Pure tone audiometry – preoperative and postoperative
- Radiological - X-ray mastoids, HRCT Temporal bones

Results

The study comprised 50 patients who underwent surgical management for cholesteatoma. The data was analyzed using the SPSS software with the significance determined using the Chi square test and the independent t test.

Table 1: Age-sex wise distribution of study subjects

Age group	Sex		Total
	Male	Female	
< 10 years	02(6.66%)	04(20%)	06(12%)
10 – 20 years	19(63.33%)	08(40%)	27(54%)
21 – 30 years	05(16.66%)	02(10%)	07(14%)
> 30 years	04(13.3%)	06(30%)	10(20%)
Total	30(100%)	20(100%)	50(100%)

The above table shows age and sex distribution of the study population. The age of the patients ranged from 6-52years. The male: female ratio is 1.6. 69% of the study population was aged less than 20years. Males aged between 10-20years were most frequently affected.

Table 2: Distribution of study subjects based on occupation

Occupation	Frequency	Percentage
Housewife	06	12%
Self employed	18	36%
Students	21	42%
Others	05	10%
Total	50	100

Students (42%) accounted for the majority of cases in our study population.

Table 3: Distribution of study subjects based on education status

Education status	Frequency	Percentage
Illiterate	08	16%
Schooling	32	64%
PUC	06	12%
Degree	04	8%
Total	50	100

Educational status of majority of the study population was schooling. Illiterates accounted for 14.3% of the study population.

Table 4: Distribution of study subjects based on side of ear involved

Ear	Frequency	Percentage
Right	15	30.0%
Left	22	44.9%
Bilateral	13	26%
Total	50	100

Bilateral disease was seen in 26%. In patients with unilateral disease the left ear was more commonly found to be affected.

Table 5: Distribution of study subjects based on ear discharge

Ear discharge	Frequency	Percentage
Present	45	90%
Absent	05	10%
Total	50	100

Ear discharge was the most common presenting symptom seen in 45 (90%) of the 50 subjects.

Table 6: Distribution of study subjects based on ear discharge characteristics

Ear discharge	Frequency (N = 39)	Percentage
<i>Type</i>		
Continuous	15	30%
Intermittent	24	48%
<i>Quantity</i>		
Scanty Profuse	16	32%
<i>Odour</i>		
Foul smelling Non foul smelling	39	100%
Quality Mucoïd Mucopurulent Purulent Blood stained	00 21 15 03	00 42% 30% 6%
<i>Duration</i>		
0 – 2 years	19	38%
2 – 4 years	04	8%
>4 years	16	32%

48% of patients had intermittent ear discharge. 46% patients had scanty ear discharge. All patients in the study population had foul smelling ear discharge. The quality of ear discharge was mucopurulent in most patients accounting for 42% of the study population. 38% of patients had ear discharge for less than 2years duration, whereas 32% of patients had the ear discharge for more than 4years.

Table 7: Distribution of study subjects based on hard of hearing

Hard of hearing	Frequency	Percentage
Present	44	88%
Absent	06	12%
Total	42	100

Hard of hearing was the second most presenting symptom seen in 88% of the study population.

Table 8: Distribution of study subjects based on hard of hearing characteristics

Hard of hearing	Frequency (N = 38)	Percentage
Causing impairment	12	24%
Yes No	26	52%
Duration		
0 – 2 years	18	36%
2 – 4 years	04	8%
>4 years	16	32%

12(24%) of 50 patients had hard of hearing causing impairment and all these subjects had bilateral disease. 36% of the study population had hard of hearing of less than 2years duration and 32% had it for more than 4years duration.

Table 9: Distribution of study subjects based on other complaints

Other complaints	Frequency (N = 50)	Percentage
Head ache	03	6%
Ear ache	15	30%
Dizziness	01	02%
Fever	05	10%
Swelling around ear	04	08%
Facial nerve palsy	01	02%
Others	02	04%

Earache was the third most common symptom seen in more than 1/3rd of the study population, followed by fever, swelling around the ear, and headache.

Table 10: Comparison of tympanic membrane findings on otoscopy vs otomicroscopy

Tympanic membrane	Otoscopy		Otomicroscopy	
	Frequency	%	Frequency	%
Perforation	25	59.5%	27	64.2%
Retraction	10	23.8%	05	11.9%
Both	07	16.7%	10	23.9%
Total	42	100%	42	100%

On Otoscopy 60% patients had tympanic membrane perforation, 24% had tympanic membrane retraction and 17% had both perforation and retraction whereas on otomicroscopy 64% had perforation, 12% had retraction and 24% had both perforation and retraction. 12% of patients having tympanic membrane perforations were falsely identified as having tympanic membrane retractions on otoscopy.

Table 11: Distribution of study subjects based on site of perforation noted on otoscopy and otomicroscopy

Site	Otoscopy		Otomicroscopy	
	Frequency	%	Frequency	%
Pars flaccida	25	50%	29	58%
Pars tensa-marginal	21	42%	21	24%
Pars tensa-central	08	16%	08	16%
Both	03	6%	02	4%
Total	50	100%	50	100%

Pars flaccida was the most common site of perforation as noted in 50% of the study population followed by marginal perforations involving the postero-superior portion of the pars tensa in 30%. Central perforation was noted in 16% of

the study population. In 4% both the pars tensa and flaccida were involved.

Table 12: Distribution of study subjects based on size of perforation noted on Otoscopy and Otomicroscopy

Size	Frequency	Percentage
Small	12	24%
Large	38	76%
Total	50	100

76% patients had large perforation and 24% patients had small perforation as noted on Otoscopy and Otomicroscopy.

Table 13: Distribution of study subjects based on middle ear pathology noted on Otoscopy

Middle ear pathology	Frequency	Percentage
Cholesteatoma only	20	40%
Granulation tissue only	04	4%
Cholesteatoma & granulation tissue	04	4%
Granulation polyp	09	18%
None	15	30%
Total	50	100

On otoscopic examination in 40% patients cholesteatoma was visualized, 18% had granulation tissue polyp, 4% each had cholesteatoma and granulation tissue and only granulation tissue.

Table 14: Distribution of study subjects based on pre-operative complications

Pre-operative Complications	Frequency	Percentage
Yes	13	26%
No	37	74%
Total	50	100%

26% patients of the study population presented with complications.

Table 15: Distribution of study subjects based on findings on Rinne's test

Rinne test	Frequency	Percentage
Mild	00	00
Moderate	30	60%
Severe	20	40%
Total	50	100%

60% of the study population had moderate and 40% had severe hearing loss as determined by Rinne's test. None had mild hearing loss.

Table 16: Distribution of study subjects based on type of deafness (PTA)

Type	Frequency	Percentage
Conductive	40	80%
Sensorineural	00	00
Mixed	10	20%
Total	50	100%

80% of the study population had conductive hearing loss and 20% had mixed hearing loss as determined by pure tone audiometry.

Table 17: Distribution of study subjects based on erosion of structures noted in HRCT

Erosion ossicles	Frequency	Percentage
Ossicles	03	37.5%
Ossicles, scutum & others	03	37.5%
Ossicles & Others	02	25%
Total	08	100%

Ossicles (100%) followed by scutum (37.5%) were most commonly noted to be eroded as noted on HRCT temporal bones.

Table 18: Distribution of study subjects based on extent of cholesteatoma noted intraoperatively

Cholesteatoma extent	Frequency	Percentage
Absent	04	8%
Limited	25	50%
Extensive	21	42%
Total	42	100%

50% of patients had limited cholesteatoma whereas 42% patients had extensive cholesteatoma as noted intraoperatively.

Table 19: Distribution of study subjects based on frequency of follow up

Follow up (number)	Frequency	Percentage
0	04	8%
1	38	76%
2	28	56%
3	16	32%

4(8%) patients were lost to follow up whereas 32% patients had all 3 follow-ups. 76% and 56% patients attended 1 month follow-up and 3 months follow up respectively.

Table 20: Comparison of preoperative and postoperative ABG

ABG	Mean (db)	Standard deviation
Pre-operative	35.59	7.1
Post-operative	21.96	9.0

Table 21: Distribution of study subjects based on postoperative complications

Complications	Frequency	Percentage
Yes	06	15.4%
No	33	84.6%
Total	39	100%

Postoperative complications were noted in 15% of the study population.

Discussion

Age and sex incidence

In our study 70% of the patients were aged less than 20years. Though cholesteatoma an present at any age, its occurrence reduces after the age of 20years according to our study. The most common age of presentation was between 10-20 years. Males were more commonly affected with a male: female ratio of 1.6. Males aged between 10-20 years were most commonly affected.

Presenting symptoms

Bilateral disease was noted in 26% of the study population. Literature suggests that 10% of cholesteatomas are bilateral [26]. Our study had a higher percentage of patients presenting with bilateral disease (26%) Otorrhea was the most common presenting symptom in our study noted in 90% of patients, followed by hard of hearing seen in 90% of the study population. Earache was seen in 36% and 10% of patients presented with post-aural swelling.

The ear discharge was more frequently found to be foul smelling (100%), intermittent (48%), scanty (46%), and mucopurulent (42%) in character. It was occasionally blood stained (8%). 29% of the study population gave history of undergoing ear surgery in the past. Of these 6 patients (12%) had undergone ear surgery in the past and presented with recurrent disease, 3 patients had undergone ear surgery on the opposite ear, 3 patients had undergone incision and drainage of post-aural abscess. One of the patients who had undergone I & D was referred from neurosurgery following drainage of temporal lobe abscess. 42% of patients presented with complications. 18% patients presented with extracranial complications and 18% of patients had intracranial complications with 5% presenting with both intratemporal and intracranial complications. The most common extracranial complication was abscess noted in 18% patients, 4 patients presenting with postaural subperiosteal abscess and 1 patient with Bezold's abscess. Facial palsy and labyrinthitis was noted in 1 patient (2%) each [5-7]. The most common intracranial complication was lateral sinus thrombophlebitis seen in 7% of patients. Meningitis and temporal lobe abscess were seen in 2.4% each of the study population at presentation. 78% of the patients who presented with complications were aged ≤ 19 years. 80% of the patients who presented with intracranial complications were aged ≤ 13 years [18].

Otoscopic and otomicroscopic findings

The most common pathology noted in the tympanic membrane on otomicroscopy was perforation. Pars flaccida was the most common site of perforation as noted in 50% of the study population followed by marginal perforations involving the postero-superior portion of the pars tensa in 30%. Central perforation was noted in 20% of the study population. In 3% both the pars tensa and flaccida were involved. Retraction of the tympanic membrane was noted in 12% and both perforation and retraction were noted in 24%. The perforation in the pars tensa was graded as large when it involved more than one quadrant and perforation in the pars flaccida was graded large when it involved more than 50% of the pars flaccida. 76% of the study population had large perforation and 24% had small perforation. 12% of patients having tympanic membrane perforations were falsely identified as having tympanic membrane retractions on Otoscopy [9].

Radiological evaluation

All patients in the study population had X-ray mastoids Schuller's view done. Only 19% of the study population underwent high resolution computed tomography scanning temporal bones. This was largely limited to patients who presented with complications. In all cases with suspected intracranial complications computed tomography scan of the brain was also performed. The most consistent finding in HRCT temporal bones was the presence of soft

tissue opacity in the middle ear and mastoids. Ossicles were noted to be eroded in all these scans. The second most common structure found to be eroded was the scutum. 50% of these scans showed the pattern of pneumatization of the temporal bones to be diploic, 37% showed a pneumatized pattern and 12% showed a sclerotic pattern of pneumatization [10].

Intraoperative findings

The most common ossicle eroded was the incus (98%) of which only the long process of incus was eroded in 26%. In 52% the malleus was noted to be eroded of which 12% patients had erosion of the malleus handle only. 48% of the patients had erosion of the stapes suprastructure [11]. The cholesteatoma was found to be involving the posterior epitympanum (80%) most commonly followed by the posterior mesotympanum (40%) and the anterior epitympanum (20%). The posterior epitympanum and posterior mesotympanum were together involved in 40% patients. The cholesteatoma was associated with granulation tissue in most cases, together causing significant ossicular erosion. In only one patient there was limited cholesteatoma involving only the anterior epitympanum, and this patient had all ossicles intact, but required ossicular reconstruction in order to accomplish complete disease clearance. Cholesteatoma was considered limited when it was noted in the middle ear, aditus ad antrum and was considered extensive when it was noted to be infiltrating into the air cells. 52% patients had limited cholesteatoma whereas 45% had extensive cholesteatoma infiltrating into the air cells, making the disease clearance challenging.

Frequently the cholesteatoma was associated with the presence of granulation tissue which by itself could be implicated as the cause for destruction of the middle ear structures.

The most common pattern of pneumatization of the mastoid was diploic seen in 36% followed by pneumatized pattern seen in 33% and sclerotic pattern was noted in 19% of the study population [12]. In the patient with facial nerve palsy House Brackmann grade III cholesteatoma was noted around the second genu and adjoining horizontal and vertical portion of the facial nerve. Also in this patient there were defect noted in the tegmen mastoideum and the sinus plate, though the patient did not have any intracranial complications.

Surgical management

All patients in the study population underwent mastoidectomy with tympanoplasty at a single stage via the post-aural approach. 36 (72%) patients underwent primary surgery for cholesteatoma. Of these, 24 (48%) underwent intact canal wall mastoidectomy and 12 (24%) patients underwent canal wall down mastoidectomy. Canal wall down mastoidectomy was done in patients with complications and in cases where adequate disease clearance could not be accomplished with the posterior canal wall intact. 14% of patients had revision surgery. Of these 6 patients, 5 had undergone canal wall down mastoidectomy in the past for cholesteatoma and presented with recurrence and 1 patient had undergone cortical mastoidectomy for cholesteatoma. In the patient who underwent cortical mastoidectomy in the past there was significant presence of cholesteatoma noted at surgery. In

the 5 patients who underwent canal wall down procedure in the past 4 had cholesteatoma and in 1 patient there was no cholesteatoma noted. 3 patients had limited cholesteatoma and 1 had extensive cholesteatoma among the 4 patients who underwent revision canal wall down mastoidectomy. These patients had irregular cavities with inadequate meatoplasty causing symptoms. All these patients underwent canal wall down mastoidectomy. All patients in the study underwent ossicular reconstruction in the form of myringoplastinopexy or myringostapedopexy. This was owing to the destruction of ossicles by the disease process. Myringoplastinopexy was done in 22 (52%) patients, 20 of these patients had destruction of the stapes suprastructure and in 2 patients myringoplastinopexy was performed to accomplish adequate disease removal. 20 (48%) of the patients in the study population underwent myringostapedopexy. The most common material used for ossicular reconstruction was synthetic materials which were used for reconstruction in 30%. Total Ossicular Reconstruction Prosthesis was used for MP and Partial Ossicular Reconstruction Prosthesis was used for MS followed by homologous septal cartilage (30%), which was used for reconstruction in both MS and MP. Autologous ossicles were used for reconstruction in 26% of patients and homologous ossicles were used in 10%. Malleus was used for reconstruction in myringoplastinopexy and incus was used for reconstruction in myringostapedopexy. Temporalis fascia graft was used for reconstruction of the tympanic membrane defect by underlay technique.

All patients underwent satisfactory removal of the disease (mastoidectomy) and hearing reconstruction (tympanoplasty) in a single stage surgery. During the past decade a number of publications have addressed the controversy of ICW versus CWD mastoidectomy for treatment of cholesteatoma. A survey of recent literature related leads to several generalizations. First, the recidivism rate, combining the residual and recurrent cholesteatoma rates, was worse for the cumulative ICW cases-42% versus the cumulative CWD cases-22%. In some reports, the residual rate includes cholesteatoma intentionally left, to be removed at a second stage. More importantly, the data demonstrate significant recidivism rates in patients, as follow-up lengthens. The average recidivism rate was 30%, ranging from 7% to 57%. Regardless of mastoidectomy technique, the failure rate is significant. Despite the impressive trends represented by these figures, the retrospective nature of these studies, biases in patient selection and surgeon preference (i.e., type of mastoidectomy, staging), and inconsistencies in reporting functional results have impeded the development of a unifying approach. One particularly large patient population was assembled by Tos and Lau⁷² to evaluate the late results of surgery for cholesteatoma. This series included 740 patients of all ages (mean age, 39 years) followed for an average of 9.2 years. The ICW procedure was used in 324 patients and the CWD in 262. In contrast to the outcome data described above, the group found no significant differences in either recurrent or residual cholesteatoma when comparing the two approaches. The authors found that the rate of recidivism was more dependent on anatomical position of the cholesteatoma and concluded that ICW is the procedure of choice based on improved hearing profiles and fewer postoperative complications.

We would similarly conclude that ICW can be considered the procedure of choice, but canal wall down procedures still have a role in the management of cholesteatomas

Conclusions

Following an initial surgery, regardless of whether an ICW or CWD technique is used, both residual and recurrent disease- recidivism are possible. Eradication of cholesteatoma has always been the priority, but with advance in the surgical techniques hearing improvement and quality of life issues need to be addressed. With this in the background, ICW mastoidectomy is the preferred choice in our study. However owing to the high incidence of residual disease it is important for the surgeon to counsel the patients regarding the probable need for multiple surgeries. Further studies with long-term follow-up is recommended.

Acknowledgment

The author is thankful to Department of ENT for providing all the facilities to carry out this work.

Conflict of Interest

None

Funding Support

Nil

References

- Haynes DS, Wittkopf J. Canal wall up Mastoidectomy. In: Gulya AJ, Minor LB, Poe DS, eds. Surgery of the ear, 6th edn. People's medical publishing house-USA, 2010, 501-14.
- Proctor B. the development of the middle ear spaces and their surgical significance. J Laryngol Otol. 1964;78:631-48.
- Marchioni D, Molteni G, Presutti L. Endoscopic Anatomy of the Middle Ear. Indian J Otolaryngol Head Neck Surg. 2011;63(2):101-13.
- Palva T, Johnsson L. Epitympanic compartment surgical considerations: Reevaluation. Am J Otol. 1995;16(4):505-13.
- Ozturan O, Bauer CA, Miller CC, *et al.* Dimensions of the sinus tympani and its surgical access via a retrofacial approach. Ann Otol Rhinol Laryngol. 1996;105:776-83.
- Steinbrugge H. On sinus tympani. Arch Otolaryngol. 1889;8:53-5.
- Weiss MH, Parisier SC, Han JC, *et al.* Surgery for recurrent and residual cholesteatoma. Laryngoscope. 1992;102:145-51.
- Pulec JL. Sinus tympani: retrofacial approach for the removal of cholesteatomas. Ear Nose Throat J. 1996;75:77-88.
- Jeng FC, Tsai MH, Brown CJ. Relationship of preoperative findings and ossicular discontinuity in chronic otitis media. Otol Neurotol. 2003;24:29-32.
- Presutti L, Marchioni D, Mattioli F, Villari D, Alicandri Ciuffelli M. Endoscopic management of acquired cholesteatoma: our experience. J Otolaryngol. 2008;4:1-7.
- Derlacki EL, Clemis JD. Congenital cholesteatoma of the middle ear and mastoid. Ann Otol Rhinol Laryngol. 1965;74:706-27.
- Levenson MJ, Michaels L, Parisier SC, *et al.* Congenital cholesteatomas in children: an embryologic correlation. Laryngoscope. 1988;98:949-55.