

Round window accessibility in transcanal approach

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Aim

Our aim of this study is to evaluate the transcanal approach to visualize the round window whose visualization is a very important and challenging topic as it is used as a portal for electrode insertion during cochlear implantation.

Methods

This study was carried out over fifty patients suffered from conductive or mixed hearing loss with intact tympanic membrane suggested to be otosclerotic patients irrespective to their age or sex. The exploratory tympanotomy procedures were performed. The tympanomeatal flap is considered to be completely elevated when the posterior edge of long process of malleus, the long process of incus, the stapes and the stapedia tendon were visible and the flap is reflected anteriorly without tension. At this step, visualization of round window is assessed microscopically and endoscopically by using an oto-endoscope of 2.7 mm diameter and 30 angle.

Results

By using the microscope, we found that 48 cases were fully visible (Type 1), 1 case was partially visible (Type 2) and 1 case was not visible (Type 3). By using the endoscope, we found that the round window details are fully visible in all the fifty cases.

Conclusion

We experienced that better exposure of round window could be achieved with less effort via transcanal approach. Using the endoscope gives panoramic view with clear details. So, transcanal approach can be used instead of classic posterior tympanotomy to visualize the round window.

Keywords:

endoscopic view of middle ear, round window, stapedectomy, transcanal approach

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Introduction

The round window is one of the two openings into the cochlea from the middle ear covered by the secondary tympanic membrane vibrating with an opposite phase to acoustic vibrations entering the cochlea through the stapes at the oval window [1]. The visualization of the round window is a very important and debatable topic, as it is used as a portal for electrode insertion during cochlear implantation [2]. The close relationship of the posterior tympanotomy approach to facial nerve forming its posterior border will compromise the exposure of round window if the facial nerve is abnormally placed, so this approach is not suitable for those with abnormal anatomy of the facial recess or mastoid [3]. In many cases, the visualization of the round window via facial recess opening is restricted when the posterior tympanotomy approach is used [4]. The visibility of the round window through posterior tympanotomy is classified into three types: type 1, fully visible (30%); type 2, partially visible (60%); or type 3, difficult to be visualized (10%) [5]. The transcanal approach in comparison with the standard posterior tympanotomy has many advantages. This approach allows better visualization of

the round window. It is easy to perform, less risky to the facial nerve and chorda tympani, and it is found to be suitable for patients with unfavorable mastoid or facial recess anatomy [6].

Patients and methods

This is a prospective study carried out over a period of 1 year from July 2014 to July 2015 in the Otorhinolaryngology Department at Mansoura University Hospitals. This study was approved by the ethical committee. In literature, we did not find any evidence establishing any effect of otosclerosis, as a disease affecting the otic capsule, on the morphology of the round window chamber. Therefore, this study was carried out over 50 patients with otosclerosis irrespective of their age or sex, provided that they have no ear discharge, normal healthy mucosa of the middle ear, normal-looking tympanic membrane, and no history of previous ear surgeries. The study excludes cases

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with discharging ear, unhealthy middle ear mucosa, tympanic membrane pathology, perforation, atrophy, sclerosis or retraction, and cases with history of previous ear surgery. All procedures were recorded and documented on DVDs.

Technique

- (1) The procedures were performed under local anesthesia by using a mixture of 2% lidocaine in epinephrine 1/100 000 to reduce bleeding or under general anesthesia with hypotensive technique if the patient is uncooperative.
- (2) The skin of the external auditory canal is incised, by using round knife, from 6 to 12 O'clock positions ~6–8 mm lateral to the annulus. The incision is then deepened until exposure of the underlying bone.
- (3) The tympanomeatal flap is elevated with a round knife toward the annulus, and when the tympanic annulus is exposed it is carefully elevated.
- (4) Curetting a portion of the posterosuperior bony meatal wall was needed in some cases to broaden the field of view for improving the exposure of the oval window and stapes and exposing the round window niche to test the mobility of the stapes by round window reflex.
- (5) The tympanomeatal flap elevation was completed when the posterior edge of long process of malleus, the long process of incus, the stapes, and the stapedial tendon were visible and the flap is reflected anteriorly without tension.
- (6) At this level, visualization of round window is assessed under a microscope and endoscopically by using an otoendoscope of 2.7 mm diameter and 30° angle.
- (7) According to the visibility of the round window, we classified the cases into three types.
 - (a) Type 1: in which the round window is fully visible.
 - (b) Type 2: in which the round window is partially visible.
 - (c) Type 3: in which the round window is not visible.

Results

Our study included 50 otosclerotic patients (16 male=32% and 34 female=68%). The age of the patients ranged from 23 to 51 years, with a mean of 34.4 years.

Table 1 The visibility of the round window via transcanal approach microscopically and endoscopically

	Totally visible	Partially visible	Not visible
Microscopic	48	1	1
Endoscopic	50	0	0

Microscopic assessment

By using the binocular microscope to visualize the round window via the transcanal approach, we found that 48 cases were fully visible (type 1), one case was partially visible (type 2), and one case was not visible (type 3).

Endoscopic assessment

By using otoendoscope of 2.7 mm diameter and 30° angle, we found that the round window niche details are fully visible including tegmen, anterior pillar, and posterior pillar in all cases, even those that were classified as type 2 or type 3 during microscopic assessment (Table 1).

The round window membrane was demonstrated endoscopically in 11 (22%) cases, whereas it could not be visualized endoscopically in 39 (78%) cases.

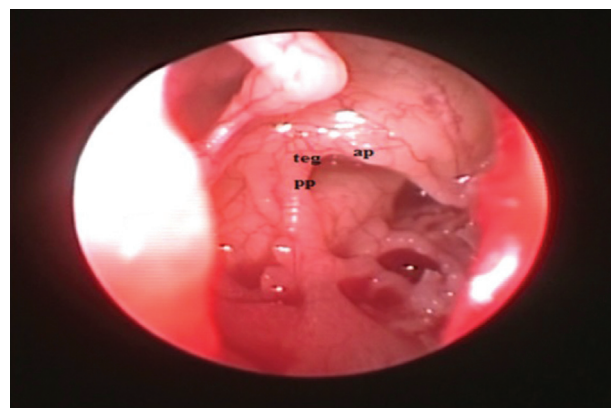
The fustis, which is a smooth bone forming the floor of the round window area, was visualized endoscopically in all cases, with 34 (68%) cases showing a wide opening located anteroinferior to the

Figure 1



Type 1 round window exposure, microscopic view.

Figure 2



Endoscopic view of type 1 shows the round window fully exposed. ap, anterior pillar; pp, posterior pillar; teg, tegmen.

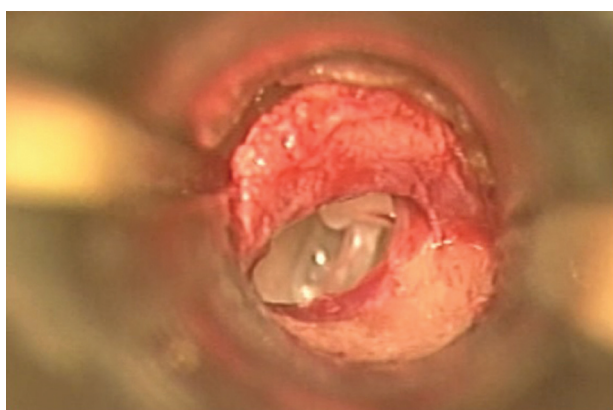
fustis and leading to a tunnel that is called the subcochlear canaliculus.

As regards the direction of the opening of the round window niche, we found that 26 (52%) cases have inferior direction, 18 (36%) cases have posteroinferior direction, and six (12%) cases have posterior direction (Figs 1–4).

Discussion

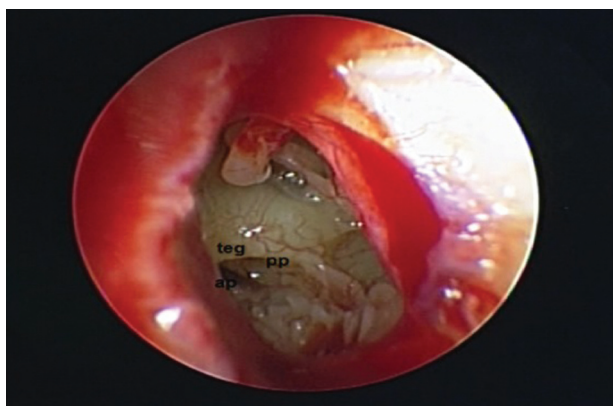
Development of cochlear implantation has raised the importance of round window approach, as it acts as a portal for electrode entry replacing the standard bony promontory cochleostomy [7]. The complete exposure of the round window via classic posterior tympanotomy approach could be achieved in only 13% of cases. In the remaining 87% of cases, it could not be achieved because of the presence of a bony ledge called ponticulus pyramidalis that is located anterior and medial to the facial nerve. This ledge needs to be drilled away to expose the round window [8]. With advancing in manufacturing recent generations of

Figure 3



Type 3 round window microscopic view.

Figure 4



Endoscopic view of type 3 shows the round window fully exposed. ap, anterior pillar; pp, posterior pillar; teg, tegmen.

microscopes, the complete visibility of the round window via the classic posterior tympanotomy approach increased to be achieved only in 30% of cases, but 60% of cases are still partially visible and 10% of cases are difficult to be visualized [5].

Approaching round window through the transcanal approach in comparison with posterior tympanotomy is an easier procedure. Endoscope, in comparison with a microscope, gives a detailed view of the anatomy of middle ear. It gives a greater magnification than the microscope. Furthermore, endoscope helps to identify the detailed anatomy of the round window including anterior and posterior pillars and tegmen [9].

Neither sex nor age affects the morphology of the round window chamber [10].

In our series, we found that round window was fully visible via the transcanal approach by using a microscope in 48 (96%) cases. Endoscope was used to visualize the round windows of all these 48 cases. All of them were totally visible with panoramic view giving their details including anterior pillar, posterior pillar, tegmen, fustis, and subcochlear canaliculus. The ability to visualize the round window membrane was achieved in 11 cases.

In one case out of our series, the round window was partially visible by a microscope (type 2). In this case, the endoscope was applied and the round window was completely visible including anterior pillar, posterior pillar, tegmen, fustis, and subcochlear canaliculus, whereas the round window membrane could not be visualized.

In one (2%) case out of our series, the round window was not visible at all by using a microscope (type 3). After application of endoscope in this case, the round window was completely visible including anterior pillar, posterior pillar, tegmen, fustis, and subcochlear canaliculus without visualization to the round window membrane.

To achieve better exposure of the round window with less effort, the transcanal approach can be used instead of classic posterior tympanotomy. Transcanal approach has the following advantages, which make it more popular nowadays.

- (1) It provides better visualization of the round window. Using the microscope achieved complete visualization in 96% of cases, whereas using the endoscope gave complete visualization with panoramic detailed view in 100% of cases with the ability to

visualize the round window membrane without drilling the niche in many cases.

- (2) It is a simple and rapid procedure.
- (3) It is safe for the facial nerve.
- (4) The healing process is faster, which reduces the postoperative complications.
- (5) It does not interfere with the anatomy, the physiology, and the growth of the temporal bone.

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Conflicts of interest

There are no conflicts of interest.

References

- 1 Zhang X, Gan RZ. Dynamic properties of human round window membrane in auditory frequencies dynamic properties of round window membrane. *Med Eng Phys* 2013; 35:310–318.
- 2 Penha R, Escada P. Round window anatomical considerations in intratympanic drug therapy for inner ear diseases. *Int Tinnitus J* 2005; 11: 31–33.
- 3 Clark G. Surgery: fundamentals and clinical practice. In: Clark G, editor. *Cochlear implants: fundamentals and application*. New York, NY: AIP Press; 2003:597–620.
- 4 Adunka O, Unkelbach MH, Mack M, Hambek M, Gstoettner W, Kiefer J. Cochlear implantation via the round window membrane minimizes trauma to cochlear structures: a histologically controlled insertion study. *Acta Otolaryngol* 2004; 124:807–812.
- 5 Pendem SK, Rangasami R, Arunachalam RK, Mohanarangam VSP, Natarajan MP. HRCT correlation with round window identification during cochlear implantation in children. *J Clin Imaging Sci* 2014; 4:1–6.
- 6 McKinnon BJ. Vibrant Soundbridge implantation: the transmastoid, posterior tympanotomy and transcanal approaches. *Oper Tech Otolaryngol* 2010; 21:189–193.
- 7 Thomson S, Madani G. The windows of the inner ear. *Clin Radiol* 2014; 69:146–152.
- 8 Jansen C. The combined approach for tympanoplasty. *J Laryngol Otol* 1968; 82:779–793.
- 9 Marchioni D, Molteni G, Presutti L. Endoscopic anatomy of middle ear. *Indian J Otolaryngol Head Neck Surg* 2011; 63:101–113.
- 10 Singla A, Sahni D, Gupta AK, Loukas M, Aggarwal A. Surgical anatomy of round window and its implications for cochlear implantation. *Clin Anat* 2014; 27:331–336.