Original Research Paper

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ANATOMICAL VARIATIONS OF SHAPE OF THE ROUND WINDOW NICHE, OBSERVED DURING ENDOSCOPIC MIDDLE EAR EXAMINATION

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ABSTRACT **Aim:** Our aim is to visualize, capture and publish pictures of our observation, of anatomical variations in the shapes of round window niche and explain their characteristic features commonly observed and also calculate the percentage of existence of each anatomical variant. **Material and Methods:** As advancement of endoscopy facilitates visualization of every loop and corner of middle ear, we pictured 100 round window niches during performing endoscopic otological surgeries in our institute, Maharajah's institute of medical sciences, Nellimarla. **Results:** we have observed Round window niche shapes and calculated the percentage of their existence which showed Rectangular shape (30%), Square (20%), Triangular (15%), Oval (15%), Semicircular (12%), Round (5%), Trapezoid (3%)and explained their characteristics, though we could not find some "literature explained" shapes, which could be very rare or difficult to identify. **Conclusion:** After BRUCE PROCTOR M.D. has studied and classified different sizes and shapes of round window niche, nowhere in literature these shapes were captured and shown. Here we have attempted shown high-definition endoscopic pictures where every detail of their characteristics can be appreciated.

KEYWORDS : Round window membrane, round window Niche, Middle Ear anatomy, Endoscopic Ear surgery.

INTRODUCTION

The round window was first discovered in 16th century, it has also become structure of surgical interest for the following reasons:

1) as a possible site of perilymph fistula in certain cases of sudden deafness.[1],[2]

2) as a route for ultrasonic treatment of Meniere's disease .[3]

3) as a landmark in the surgical approach to divide the posterior ampullary nerve for relief of benign paroxysmal positional vertigo.[4]
Round window is the shyest part of the middle ear, it hides itself in the cover of round window niche. The angulation of both the round window niche and membrane with respect to the external auditory canal as well as the depth of the niche are the most important factors which make it difficult for visualization during surgical procedures on the middle ear like cochlear implant surgeries.

In the middle ear most of the spaces are considered to be difficult to access with a microscopic technique, and could be easily accessed by endoscope assisted surgery.[5] Round window membrane is one of them, it can be visualized beyond the niche with angled Endoscopes transmeatally and can guarantee a very detailed view and allow the exploration of the round window region, and study the exact anatomical knowledge of this region since some pathology can invade inside cavities or tunnels.[5]

Figure 1 Round Window Membrane

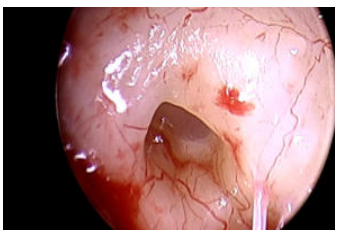


Figure 2 Round Membrane Niche

In this paper we had seen round window niche of 100 patients, and calculate the average percentage of different anatomical variations in regard to the shapes of round window niche which we had encountered during our Endoscopic middle ear surgeries and discuss their anatomical features.

DISCUSSION

The anatomy of the round window niche was described in 1972 by Bella Bollobas. [6]

In the 4-month-old embryo, ossification has started in the otic capsule. The round window niche is surrounded with a thickened ring of cartilage which prevents its closure.

It forms the postis posterior (posterior pillar of the niche), tegmen fossula fenestra rotunda (roof support), and the postis anterior (anterior pillar of the niche). Between the oval and round window niches is the subiculum promontorii (underlying structure of the promontory) bridging the styloid eminence posterolaterally to the promontory. [7]
Anterior to the postis anterior we find a supporting pillar of bone formed around the inferior tympanic artery, the sustentaculum promontorii (recently called Finiculus). It extends onto the promontory from the foramen in the hypotympanum to accompany Jacobson's nerve. Between the postis anterior and the sustentaculum, we occasionally see the tunnel of the promontory, which extends for a variable distance under the basal coil of the cochlea and often as far as the carotid canal.(Subcochlear tunnel).[7]

The round window chamber was defined as the three- dimensional space lying between the round window niche and the round window membrane and it was also evaluated endoscopically along with the presence of the fustis bone and Proctor's area concamerata. [7]

The fustis was defined as the thick smooth bone linking the basal turn of the cochlea with the styloid prominence, located within the round window chamber and extending from the styloid complex into round window niche, indicating the entrance to the round window niche. [7]
The Proctor's area concamerata (Subtympanic sinus) was defined as an anatomical area composed by bony cells developed around the fustis bone.[7]

Anatomical variations of Round Window Niche according to Bruce Proctor classification [8] :

According to position:
1) Horizontal Aperture
2) Dorsal Aperature
3) Ventral Aperature

According to the Size:
1) Fossula Fenestrae Rounda Lata (broad and short)

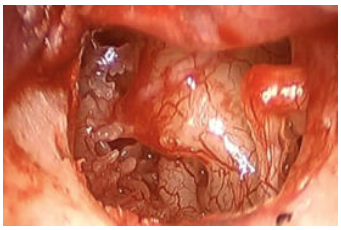


Figure 3 : Fossula Fenestrae Rounda Lata

2) Fossula Fenestrae Rounda Alta (narrow and high)

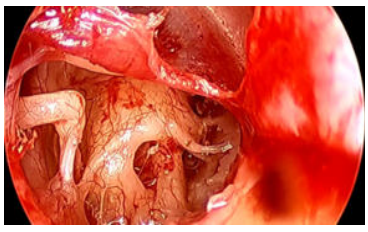


Figure 4 : Fossula Fenestrae Rounda Alta

According to the Shape :
1) Fossula Fenestrae Roundae Lateritia (Rectangular)
2) Fossula Fenestrae Roundae Quadrata (Square)
3) Fossula Fenestrae Roundae Triangularis (Triangular)
4) Fossula Fenestrae Roundae Ovalis (Oval)
5) Fossula Fenestrae Roundae Semicircularis (Semicircular)
6) Fossula Fenestrae Rounda Roundae (Round)
7) Fossula Fenestrae Roundae Semilunar (semilunar)
8) Fossula Fenestrae Roundae Rhomboidea (Rhomboid)
9) Fossula Fenestrae Roundae Trapezoides (Trapezoid)
10) Fossula Fenestrae Roundae Inversa

According to the Structure:
1) Fossula Fenestrae Roundae Dentata
2) Fossula Fenestrae Roundae spinosa
3) Fossula Fenestrae RoundaeTrabecularis

MATERIAL AND METHODS

Photographs are taken in our institute, Maharajah's institute of medical sciences, Nellimarla. For the patients who had been operated by us for different otological procedures performed endoscopically with their consent. Endoscopes of 0, 30, and 70 degrees connected to high-definition cameras were used to explore, visualize and take the pictures of the round window membrane niche of different patients.

RESULTS

According to the Shape:
Fossula Fenestrae Roundae Lateritia (Rectangular) 30%

- Rectangular in shape smaller than round window.
- The postes posterior is missing and replaced by subiculum.
- Fustis is broad and wide with marked excavations on its sides.
- Fundus has well developed trabeculae, with thick jugular wall, low lying jugular bulb.

Figure 5

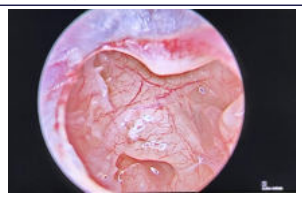


Figure 6
Figures 5& 6 showing Rectangular shaped Round Window Niche.

Fossula Fenestrae Roundae Quadrata (Square)20%

- Square shaped.
- medium sized or small chamber.
- the length of two postes are equal to that of the tegmen and fundus connected at right angles.
- The postes anterior is thin and protrude towards fundus.
- The Fustis is wide and smooth, fills the fundus and bifurcates within the chamber.
- The ponticulus is prominent.

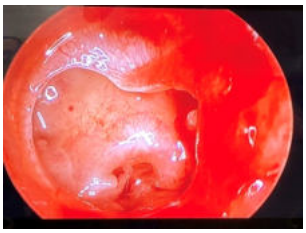


Figure 7

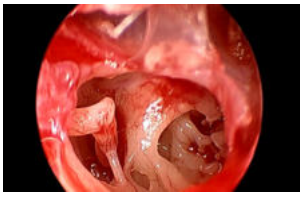


Figure 8
Figures 7&8 showing square shaped Round Window Niche

Fossula Fenestrae Roundae Triangularis (Triangular) 15%

- The chamber is Triangular and comparatively smaller with two postes as sides of triangle and fundus as base.
- Tegmen is practically absent.
- Both postes are prominent and run obliquely towards each other to meet at the apex forming a smooth arch.
- Broad subiculum with well-developed arms.
- More trabeculae with deep hypotympanum.

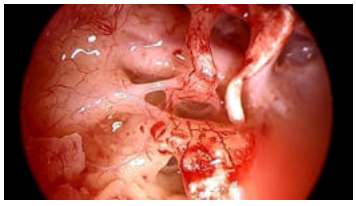


Figure 9

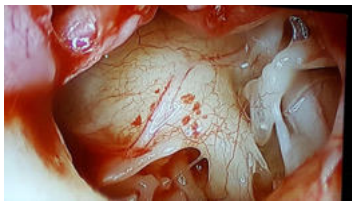


Figure 10
Figures 9&10 showing Triangular shaped Round Window Niche

Fossula Fenestrae Roundae Ovalis (Oval) 15%

- The Round window niche is Oval in shape.
- Postes posterior is well developed and smooth surfaced, it bends over the tegmen.
- Postes anterior is missing.
- Hypotympanum is deep cellular with trabeculae Fossula.

Figure 11

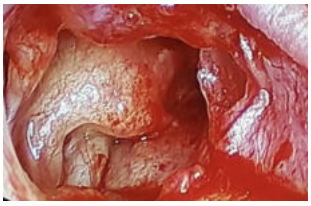


Figure 12
Figures 11&12 showing Oval Shaped Round Window Niche

Fenestrae Roundae Semicircularis (Semicircular) 12%
- The chamber entrance is almost horizontal.
- The Postes posterior is low and wide and forms circular angle with tegmen.
- Tegmen is convex with smooth surfaces
- Prominent subcochlear tunnel maybe seen.

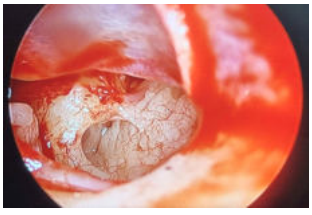


Figure 13

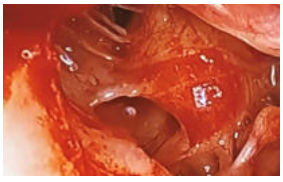


Figure 14
Figures 13&14 showing Semicircular shaped Round Window Niche.

Fossula Fenestrae RoundaRoundae (Round) 5%
- Small Round window chamber.
- Both postes are well developed, smooth, thick and fuse with arched tegmen.
- Budged tegmen forms closure of the circle and decides itself into two parts.

a) Inner part which runs in the fundus of the chamber.
b) Outer parts which runs to the stolid prominence.

- Marked convex and poorly structured promontory.
- Thick Jugular wall.

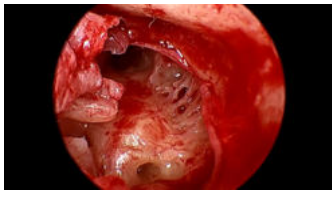
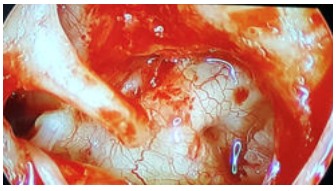


Figure 15



Figures 15 &16 showing Round Shaped Round Window Niche.

Fossula Fenestrae Roundae Trapezoides (Trapezoid) 3%
- Compressed cochlear capsule in carotico facial angle.
- Deep hypotympanum.
- Long trabeculae including trabicula longa.
- Wide concamerate lateralis and absent concamerate medialis.
- Wide postisposticus with subcochlear tunnel.
- Wide sinus tympani.

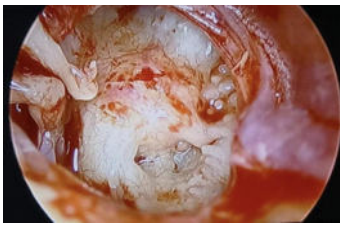


Figure 17

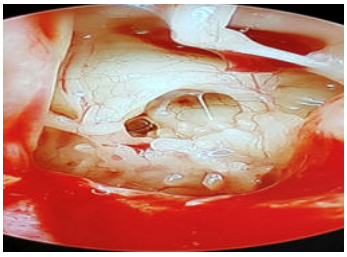


Figure 18
Figures 17 &18 showing Trapezoid shaped Round Window Niche.

Figure 19 showing percentage of various shapes of Round Window Niches observed.

CONCLUSIONS

Here we attempted to show pictures and our observation of anatomy of different shapes of round window niche. We have observed 100 Round windows and discovered certain shapes as discussed above, though we could not find some literature explained shapes which could be very rare or difficult to identify.

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