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Role of Preoperative HRCT Temporal Bone in Predicting the Round Window Visibility in Pediatric Cochlear Implantation

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ABSTRACT

Background: The HRCT temporal bones plays major role in preoperative assessment of middle and inner ear anatomy before cochlear implantation.

Objective: To find whether the preoperative HRCT temporal bone helps in prediction of Round Window visibility during cochlear implantation.

Methods: Three radiologic measurements were performed on the HRCT (Axial cuts) and these measurements were correlated with the degree of RW visibility during CI surgery.

Results: Twenty five ears of 25 children were included in the current study. A significant correlation was found between the degree of RW visibility and the following: 1) the angle between RW, facial nerve (FN), and the coronal axis (p<0.001); 2) the vertical distance between RW and FN (p 0.003).

Conclusion: The angle between RW, FN, and the coronal axis and the vertical distance between RW and FN are important parameters to be assessed in preoperative HRCT temporal bones before cochlear implantation. In children, the operative surgeons can depend on these parameters in order to assess the visibility of round window memberane during cochlear implantation.

Keywords: HRCT temporal bone, cochlear implantation, Facial recess width, the round window visibility

INTRODUCTION

The field of cochlear implantation has seen a rapid growth in recent years. The most commonly used approach for cochlear implant surgery worldwide is the posterior tympanotomy approach described by House[19,20]. The cochlear implant electrodes are inserted through the round window to the scala tympani of cochlea.

The anatomic variability of the round window of the cochlea is of importance in relation to its use as a portal for cochlear implant insertion[10,11]. That variability includes differences with respect to the surface area of the round window membrane and in the degree to which the membrane is exposed to view in individual subjects. The round window niche varies in its orientation with respect to the facial recess and tympanic membrane, which may limit its visibility during implant surgery.

This route for insertion of electrodes has many advantages such as lower risk of trauma to cochlea, because by this route there is no requirement for

direct drilling into the cochlea limiting the possibility of bone dust entrance into scala tympani[11-13].

Also, insertion of electrodes through round window confirms introduction of electrodes into the scala tympani directly. So the electrodes can be placed in perimodiolar position adjacent to the osseous spiral lamina thus increasing the chance of stimulating residual nerve dendrites.[1,2]

So, with the help of preoperative HRCT we assessed the round window visibility intraoperatively and also the width of the facial recess. Many surgeons mainly Kashio et al. assessed the round window visibility by radiological measurements by measuring the external auditory canal angle[12]. But it was very difficult to measure in paediatric age group.

The main aim of this study is to identify the most easy and applicable way to assess the visibility of round window with HRCT

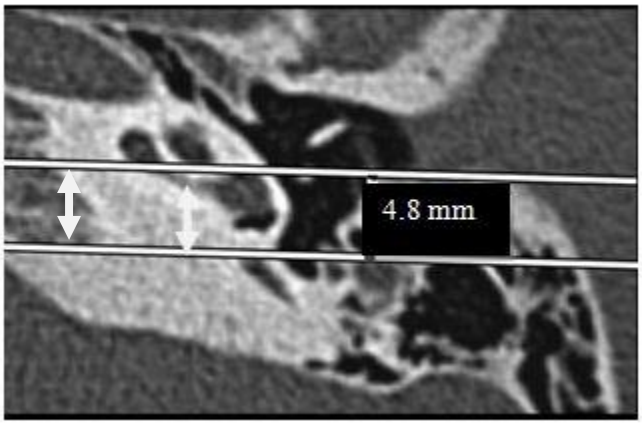
PATIENTS AND METHODS

We have conducted retrospective study of cochlear implant candidates in our hospital from May 2018 to November 2020.25 patients were included in the study. The children of age group 2 to 5 years were included. Children with middle or inner ear anomalies or with any middle ear diseases were excluded. All patients HRCT of 2mm thickness (axial cuts) were studied.

RADIOLOGIC MEASUREMENTS

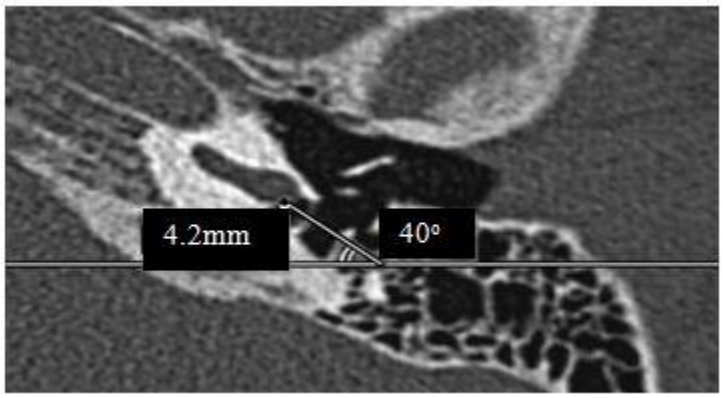
The radiological measurements were done in axial cut with maximum visibility of the Round Window niche and Round window membrane. We measured the following parameters

1. Facial Recess Width – the vertical distance between the Anterolateral part of facial nerve and the External Auditory Canal.



A coronal axis line drawn at midpoint between the facial nerve and round window

2. Angle between the coronal axis line and Round Window Niche assessed



3. The vertical distance between the Facial Nerve and Round Window

Volume 3, Issue 6; November-December 2020; Page No 752-755

STATISTICAL ANALYSIS

Results were compared statistically using the SPSS V21 software. When p value is less than 0.05, it is considered significant.

RESULTS AND DISCUSSION

Twenty five children were included in our study; 14 were male and 11 were female. Their ages were from 2 to 6 years. No bilateral Cochlear implant subjects were included in our study.

The mean measurement of Facial Recess Width was 5.02 ± 0.6mm. The mean measurement of the angle between the angle between coronal line and round window niche was 3.9 mm to 6.05mm. The mean measurement of the vertical distance between the round window and facial nerve was 4.60 ± 1.2mm.

The intraoperative visibility of round window from the surgical point of view was assessed by St. Thomas classification. Type 1 - 100 % visible. Type 2 - partially visible. Type 3 - invisible round window.

A significant correlation was found between the degree of Round window visibility with 1.The angle between the coronal line axis and round window niche and

2. The vertical distance between the round window and facial nerve.

When the vertical distance between the round window and the facial nerve was > 4.5 mm the round window visibility is good intraoperatively.[2,4]

Round window insertion of electrode results in fine placement of electrodes in scala tympani.

During cochlear implantation injury may occur at the site of cochleostomy, along the path of electrode insertion or late injury like fibrosis / new bone formation may occur[15-17].

Thus the fine insertion of the electrode under vision is important to decrease the intracochlear damage and to preserve hearing.

The round window is conical in shape. Its vertical part located antero inferiorly and its horizontal portion is postero – superiorly. And it is prone for more anatomical variations.[6-9]

The round window is 2.5 mm length and 1.5mm width. The round window niche is covered by the secondary tympanic membrane.[12] Kashio et al documented that the completely visible round window to be the most common where as in our study the type 2 partially visible were found to be most common.

CONCLUSION

The vertical distance between the facial nerve and the round window and the angle between the coronal axis line and the round window niche are correlating well with the degree of intraoperative visibility of round window during cochlear implantation in children.

These suggested parameters of preoperative HRCT Temporal bones were easily applicable, reliable and measurable in children even with good correlation with visibility of round window intraoperatively.

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Volume 3, Issue 6; November-December 2020; Page No 752-755

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Volume 3, Issue 6; November-December 2020; Page No 752-755