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Original Research Article

A clinical study of cochlear implant electrode placement via posterior tympanotomy approach in cases with varying types of round window visibility

Bharath Muniraju[1]*, Mohan Kameswaran[2], Raghu Nandhan[2], Kiran Natarajan[2], Vijaya Krishnan Paramasivan[2], Sachu Jacob James[1]

[1]Department of Otorhinolaryngology, Head and Neck Surgery, Army Hospital Research and Referral, New Delhi, India
[2]Madras ENT Research Foundation, Chennai, Tamil Nadu, India

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***Correspondence:**
Dr. Bharath Muniraju,
E-mail: drbharath2607@gmail.com

ABSTRACT

Background: Cochlear implantation (CI) is an established intervention for severe to profound hearing loss not benefiting from hearing aids. Posterior tympanotomy is the standard surgical approach to access the basal turn of the cochlea for electrode insertion via the round window or cochleostomy. However, the visibility and accessibility of the Round window membrane (RWM) may vary depending on anatomical variations. This study aimed to evaluate the utility of the Saint Thomas Hospital (STH) classification in assessing round window visibility and its relationship to the practical ease of electrode insertion.
Methods: This retrospective study analysed 511 cochlear implantations performed via the posterior tympanotomy approach in 476 children. The round window was classified according to the STH classification. The method of electrode insertion used in each case was documented and analysed.
Results: Type IIA round window was the most common variant, observed in 282 cases (55.2%), while Type III was the least common, occurring in 64 cases (12.5%). Direct round window insertion was feasible in all cases with Type I and Type IIA round windows. In 96 cases with Type IIB round window, an extended round window technique was required for electrode insertion. All 64 cases with Type III round window required cochleostomy due to inadequate round window access.
Conclusions: The study demonstrates the clinical utility of the STH classification in predicting the feasibility of round window electrode insertion during cochlear implantation. This classification can assist surgeons in determining the most appropriate method of electrode insertion based on intraoperative STH classification.

Keywords: Cochlear implantation, Round window STH classification, Round window insertion, Cochleostomy insertion

INTRODUCTION

Cochlear implantation is the treatment of choice for patients with bilateral profound hearing loss with no benefit with hearing aids.[1] There are various approaches for Cochlear implantation.[2] In most of the Cochlear implant centres all over the world, the commonly performed standard approach is through posterior tympanotomy. Electrode insertion into the cochlea is done by either Round window insertion (RWI) or by cochleostomy. Currently, there is a paradigm shift of electrode insertion from conventional cochleostomy to

round window insertion because of decreased acoustic trauma, less chances of perilymph leak, decreased risk of infections and availability of wider stimulation of surface area length by 2mm.[3,4] The RWI may offer several advantages over a cochleostomy, and it is a reliable, safe, and effective technique for cochlear implantation with today's cochlear implant electrodes.[5]

Appearance of round window through posterior tympanotomy varies depending on its anatomy of bony covering over round window known as round window niche. For complete exposure of round window, the bony overhang in the antero-superior, superior and posterior parts of the Round window niche (RWN) may have to be removed. There are various grading systems depending on the exposure of round window membrane seen through the posterior tympanotomy. We have followed Saint Thomas Hospital (STH) classification (Table 1) of round window membrane after adequate removal of the RWN, which is the most popularly accepted classification worldwide.[6]

METHODS

Retrospective descriptive study was carried out in a tertiary Cochlear implant centre in South India. Ethical approval with the permission of Institutional Review Board was taken in Jan 2024. Data was extracted from hospital medical records department and there were no conflict of interests or funding involved in the study.

Study design

The study data was collected from December 2018 to December 2023. Retrospective data of children aged 1 to 6 years with bilateral profound hearing loss who underwent CI at this centre was collected from the institution's database and were included in the study. Children with malformations of middle ear, inner ear on imaging, syndromic features, and who underwent revision surgeries were excluded from the study.

The total number of patients in the study were 476; out of which 263 (55%) were male and 213 (45%) were female. The mean age of the children undergoing the Cochlear implant was 3.6 years. 441 (93%) children underwent unilateral cochlear implant, and 35 (7%) children underwent bilateral Cochlear implant (35x2=70). So total number of Cochlear implant surgeries n=511 performed in paediatric population, who met the inclusion, exclusion criteria were analysed retrospectively, and the descriptive study was done for the type of round window as per STH classification and method of electrode insertion in each case that was already documented in the database of the Institute.

Statistics

All the demographic data and operative findings collected from the institutional database for the study were analysed by a biostatistician. Appropriate statistical analysis was performed by STATA 11.2 (College Station TX USA). Chi square test for goodness of fit was used to measure the types of RWM, methods of insertion and the results are expressed in frequency and percentages.

RESULTS

With STH classification for grading of RWM, 282/511 (55.2%) cases were found to have Type IIA followed by 96/511 (18.8%) cases had Type IIB. The most common type of round window found was Type IIA. Type I RWM was found in 69/511 (13.5%) and Type III in 64/511 (12.5%) cases respectively (Figure 1).

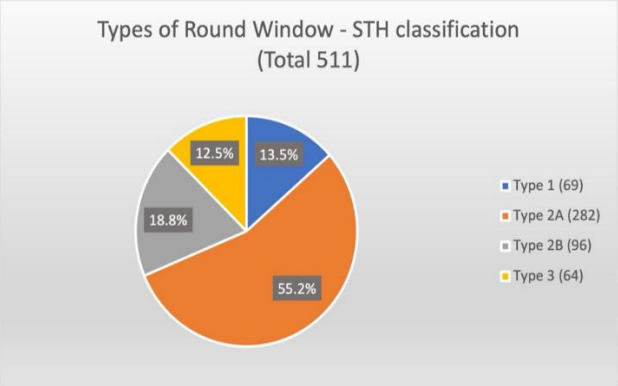

Figure 1: Types of round window- STH classification.

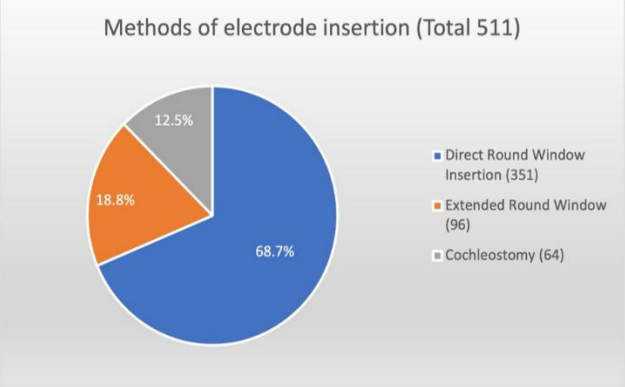

Figure 2: Methods of electrode insertion.

Out of 511 Cochlear implants, 351 (68.7%) cases had direct round window insertion, 96 (18.8%) cases had extended round window insertion, 64 (12.5%) cases had cochleostomy for insertion of electrode (Figure 2). In all Type I and Type IIA cases, direct round window insertion of electrodes was possible.

In Type IIB, all cases required extended round window exposure technique for insertion of electrode. Type III cases required cochleostomy for insertion of electrode. The result of the study is shown in Table 2.

Table 1: St. Thomas hospital classification. RWM: round window membrane.

Type of RWM	Percentage of exposure of RWM
Type I	100%
Type IIA	>50%<100%
Type IIB	<50%>0%
Type III	RWM cannot be identified

Table 2: Results of the study.

Type of RWM	Number of cases (n)	Percentage (%)
Type of RWM through Posterior tympanotomy		
Type I	69/511	13.5
Type IIA	282/511	51.3
Type IIB	96/511	18.8
Type III	64/511	16.4
Type of insertion of electrode into cochlea		
Direct round window insertion	351/511	64.8
Extended round window insertion	96/511	18.8
Cochleostomy	64/511	16.4

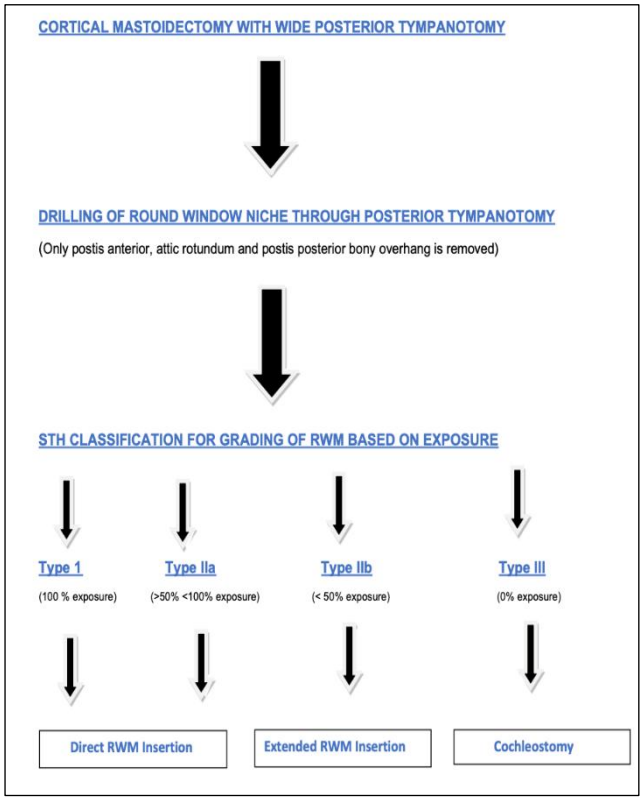

Figure 3: Algorithm for methods of electrode insertion in various types of round window based on STH classification.

Table 3: Method of electrode insertion in various types of RWM.

Types of RWM	Type of insertion
Type I (100% RWM exposure)	Direct RWM insertion
Type IIA (>50% <100% RWM exposure)	Direct RWM insertion
Type IIB (>0% <50% RWM exposure)	Extended RWM insertion (crista fenestra is drilled out)
Type III (0% RWM exposure)	Bony cochleostomy

DISCUSSION

The soft surgery technique for hearing preservation in Cochlear implantation has been the topic of discussion for several years. The round window approach has been advocated as a method to reduce insertion trauma and preserve residual hearing.[7] However, accessing the round window membrane could be difficult due to the bony overhang of the round window niche.[8] Additionally, the variable size and orientation of the round window may make electrode insertion difficult and challenging.[9] In our study, all cases underwent wide optimal posterior tympanotomy and removal of bony overhang around the RW. Grading of RWM was done as per the STH classification-type I is 100% visualization of RWM, type IIA is greater than 50% and less than 100% visualization of RWM, type IIb is less than 50% visualization of RWM and type III is RWM not visualized (Table 1).[6] In a study conducted by Panda et al RWM grading was done through posterior tympanotomy before drilling the RWN which showed grade III (less than 25% visualization of RWM) as the commonest type of RWM.[10] The grade III RWM of their classification corresponds to the Type IIA STH classification after drilling of the RWN since drilling of the RWN or bony overhang increases the visualization of RWM up to three times.[11] As per STH classification in our study, we found that Type IIA (55.2%) is the most common type of RWM and Type III (12.5%) is the least common variety. Endoscopic view of middle ear cavity through posterior tympanotomy marking the boundaries of RWN is shown in Figure 1. Types of RWN as per STH classification is shown in Figure 2.

Direct round window insertion of the electrode array is when electrodes are inserted without any further drilling around the RWM after removal of the round window niche (only posterior pillar, tegmen rotunda are drilled). Extended RWM insertion requires drilling around the exposed part of RWM, particularly the anterior inferior part of bony ridge (removal of crista fenestrae). Extended RWM insertion is done when RWM is not seen adequately even after the removal of RWN.

Cochleostomy is performed by drilling on the promontory antero inferiorly at the level of RW when RWM is not seen, that is 2 mm inferior to oval window on the promontory in anteroinferior direction.

In our study we found that all type I (13.5%) and type IIA (55.2%) cases had direct RWM insertions. All Type III (12.5%) cases had conventional bony cochleostomy while the type IIB (18.2%) cases had extended round window insertion. A similar study done by Iqbal et al with STH classification also found that type IIA (47%) is the commonest RWM in the paediatric population.[12] All type I and type III cases in their study had direct RWM insertions and cochleostomy respectively which is analogous to our study. Most of the type IIA cases and type IIB cases in their study had direct RWI and ERWI respectively which closely resembles the results of our study.

Till date, we found that though there are different grading systems for types of RWM, there is no definite criterion for the method of insertion of electrodes depending on the various types of RWM. Based on the observations and the results of our study, we have derived a criterion for method of electrode insertion in various types of round window membrane (Table 3). All type I and type IIA cases, where exposure of RWM is more than 50% to 100%, method of insertion of electrode is by direct round window.

All type IIB cases require extended round window technique by removing the bony covering of round window in anterior inferior part (crista fenestrae) for electrode insertion. All type III cases are usually associated with the need for cochleostomy. The authors found the STH classification as the best guide for the surgeon to assess the types of RWM and propose the criteria for various routes of insertion depending on types of RWM. This study result has assisted in bringing out an algorithm for various methods of electrode insertions in different types of RWM (Table 4). A similar prospective study in future with a multicentric cohort will be more useful since the current study is retrospective.

Limitations

One of the limitations of the study is subjective nature of STH classification for types of RWM and absence of CT correlation with intra-operative finding. Optimal posterior tympanotomy anatomical limits to expose RWM is not defined. Complications and outcomes were not included in our study.

CONCLUSION

This study has currently analysed the types of round window through posterior tympanotomy in the Indian paediatric population with normal temporal bone anatomy and our study revealed that Type IIA is the most common RWM that requires direct round membrane insertion, type III is the least common variant that mandates cochleostomy. STH classification aids the surgeon not only for grading of RWM but also helps the surgeon to decide the method of electrode insertion depending on the type of RWM. A rational approach in performing cochlear implantation is vital and the proposed criteria can facilitate the surgeon to decide on the appropriate method of electrode insertion depending on the type of round window membrane visibility.

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REFERENCES

1. Papsin BC, Gordon KA. Cochlear Implants for Children with Severe-to-Profound Hearing Loss. N Engl J Med. 2007;357(23):2380-7.
2. Aljazeeri I, Alturaiki S, Abdelsamad Y, Alzhrani F, Hagr A. Various approaches to the round window for cochlear implantation: a systematic review. J Laryngol Otol. 2023;137(10):1064-82.
3. Paprocki A, Biskup B, Kozłowska K, Kuniszyk A, Bien D, Niemczyk K. The topographical anatomy of the round window and related structures for the purpose of cochlear implant surgery. Folia Morphol (Warsz). 2004;63(3):309-12.
4. Roland PS, Gstöttner W, Adunka O. Method for hearing preservation in cochlear implant surgery. Oper Tech Otolaryngol Head Neck Surg. 2005;16(2):93-100.
5. 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 Oto-Laryngologica. 2004;124(7):807-12.
6. Leong AC, Jiang D, Agger A, Fitzgerald-O'Connor A. Evaluation of round window accessibility to

cochlear implant insertion. Eur Arch Otorhinolaryngol. 2013;270(4):1237-42.
7. Luers JC, Hüttenbrink KB, Beutner D. Surgical anatomy of the round window-Implications for cochlear implantation. Clin Otolaryngol. 2018;43(2):417-24.
8. Proctor B, Bollobas B, Niparko JK. Anatomy of the round window niche. Ann Otol Rhinol Laryngol. 1986;95(1):444-6.
9. Kataria T, Sharma S, Lakhawat RS, Grover M, Sharma S, Kanodia A, et al. A Study of Round Window and its Adjacent Anatomy to Guide the Cochlear Implant Electrode Insertion. Indian J Otolaryngol Head Neck Surg. 2023;75(1):163-9.
10. Panda NK, Kameswaran M, Patro SK, Saran S, Nayak G. Evaluation of round window accessibility for electrode insertion: Validation study from two centers. J Otolaryngol ENT Res. 2017;8(5):00263.
11. Roland PS, Wright CG, Isaacson B. Cochlear implant electrode insertion: the round window revisited. Laryngoscope. 2007;117(8):1397-402.
12. Junaid M. Insertion of cochlear implant electrodes through round window membrane: its accessibility in pediatric population. Glob J Otolaryngol. 2020;23(2):556109.

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