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Original Research Article

Pre-Operative CT and MRI Evaluation of Cochlear Implant Candidates: A Prospective Descriptive Study

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Abstract

Background: Cochlear implantation is the established surgical intervention for severe to profound bilateral sensorineural hearing loss (SNHL) in children who derive no benefit from conventional hearing aids. Accurate pre-operative radiological assessment using High-Resolution Computed Tomography (HRCT) and Magnetic Resonance Imaging (MRI) of the temporal bone is critical for surgical planning, risk stratification, and optimizing post-operative outcomes. Aim of this study is to evaluate the complementary diagnostic role of HRCT and MRI of the temporal bone in children who are cochlear implant (CI) candidates, to identify anatomical variants, congenital malformations, and radiological findings that may influence surgical decision-making and predict operative complications.

Methods: This prospective descriptive study enrolled 35 children (aged 1–12 years) with bilateral profound SNHL (>90 dB) meeting standard CI candidacy criteria. HRCT temporal bone (0.5 mm thickness, bone algorithm) and MRI (1.5 Tesla, heavily T2-weighted sequences with brain screening) were performed. Radiological findings were correlated with intraoperative observations and post-operative audiological outcomes at three-month follow-up.

Results: Of 70 ears evaluated, mastoid air cells were pneumatic in 42%, diploic in 23%, mixed in 21%, and sclerotic in 14%. Mastoid emissary veins were present in 97% of ears. Jugular bulb was high-riding in 21% and dehiscent in 6%. Cochlear morphology was abnormal in 4% (Mondini's dysplasia, incomplete partition type I). The VIII nerve was abnormal in 17% of ears on MRI. Central auditory pathway was intact in all cases. Pre-operative radiological findings in concordance with intraoperative findings in 91% of patients. Post-operative good sound detection was achieved in 94% and good speech discrimination in 85% of patients.

Conclusion: HRCT and MRI are complementary imaging modalities that are indispensable in the pre-operative evaluation of CI candidates. Together, they facilitate selection of the appropriate ear for implantation, anticipate surgical hazards, and guide electrode placement, thereby contributing to favourable audiological rehabilitation outcomes in children.

Keywords: Cochlear implant; sensorineural hearing loss; HRCT temporal bone; MRI temporal bone; vestibulo-cochlear nerve; Mondini's dysplasia; pre-operative imaging; labyrinthine malformations; jugular bulb anomalies; facial nerve course.

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Introduction

Sensorineural hearing loss (SNHL) is the most prevalent sensory deficit in childhood, with an estimated prevalence of 1–2 per 1,000 live births in the moderate-to-severe range. Of these, membranous labyrinth anomalies account for approximately 80% of cases, while bony labyrinth anomalies account for the remaining 20%. [1] Bilateral profound SNHL in children imposes significant barriers to speech and language acquisition, necessitating early intervention to exploit the critical window of auditory cortical plasticity. Cochlear implantation (CI) has emerged as the standard of care for children with bilateral profound SNHL who derive no functional benefit from binaural hearing aids. The procedure involves surgical insertion of an electrode array into the scala tympani of the cochlea, with the aim of directly stimulating the spiral ganglion fibres, thereby bypassing the damaged cochlear hair cells. Outcomes are markedly superior when implantation is performed before the age of two years, enabling near-normal speech and language development. [2]

Pre-operative radiological evaluation of the temporal bone is an indispensable component of the multidisciplinary CI work-up. High-Resolution Computed Tomography (HRCT) of the temporal bone delineates bony labyrinthine architecture, cochlear morphology, mastoid pneumatisation, facial nerve canal course, the dimensions of the internal auditory canal (IAC), and the relationships of major vascular structures including the sigmoid sinus, jugular bulb, and internal carotid artery. Magnetic Resonance Imaging (MRI), particularly heavily T2-weighted sequences, complements HRCT by characterising the membranous labyrinth, confirming patency of the fluid-filled cochlear scalae, visualising the vestibulocochlear nerve, and assessing the integrity of the central auditory pathway. [3,4]

The dual-modality imaging approach detects anatomical variants and congenital malformations that could modify the surgical strategy, influence the selection of the implant ear, determine electrode type and insertion technique, or serve as contraindications to surgery. [5,6] Importantly, imaging findings that predict intraoperative hazards—such as aberrant sigmoid sinus, dehiscent jugular bulb, anteriorly placed facial nerve, or labyrinthitis ossificans—must be systematically reported to minimise intraoperative morbidity.

Despite the well-recognised importance of pre-operative imaging, institutional data describing the radiological spectrum of temporal bone abnormalities in a South Indian paediatric CI population, and their correlation with intraoperative findings and audiological outcomes, are sparse. This study was conducted to address this gap and to define a structured imaging reporting protocol relevant to the CI surgical team.

Aim of this study is to evaluate the complementary diagnostic role of HRCT and MRI of the temporal bone in children who are cochlear implant (CI) candidates, to identify anatomical variants, congenital malformations, and radiological findings that may influence surgical decision-making and predict operative complications.

Materials and Methods

This was a prospective descriptive study conducted at the Department of Radiodiagnosis at a tertiary care teaching hospital in South India, in collaboration with the Department of Otorhinolaryngology of the same institution. The study was conducted from over an 18-month period. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study, and informed written consent was obtained from the parents/guardians of all enrolled children. The study conformed to the principles of the Declaration of Helsinki.

The study population comprised children of both sexes aged 1–12 years with a confirmed diagnosis of bilateral sensorineural hearing loss who fulfilled the standard criteria for cochlear implant surgery. A sample size of 35 patients was calculated using the nMaster software version 2.0 (single proportion, absolute precision method; expected proportion 0.33, precision 10%, 95% confidence level), ensuring adequate statistical power for the study objectives.

Children fulfilling all of the following criteria were enrolled: (i) bilateral profound SNHL with at least 90 dB hearing loss at 1000 Hz on Brainstem Evoked Response Audiometry (BERA) and Behavioural Observation Audiometry (BOA); (ii) little or no benefit from appropriately fitted binaural hearing aids after a minimum three-month trial; (iii) lack of progress in auditory skills development despite amplification and intensive rehabilitation; (iv) Intelligence Quotient (IQ) greater than 80 on the Stanford–Binet Intelligence Scale; and (v) parental assent for cochlear implant surgery and commitment to post-operative audiological rehabilitation.

Children were excluded if they presented with major dysplasia or aplasia of the cochlea, aplasia of the cochlear nerve, deafness attributable to lesions of the central auditory pathways, or did not meet the audiological or phoniatric criteria for CI surgery.

All children underwent a standardised pre-operative evaluation protocol. Audiological assessment included BOA, Impedance Audiometry (IA), Distortion Product Oto-Acoustic Emissions (DPOAE), and BERA. Psychometric evaluation using the Stanford–Binet Intelligence Scale was performed by a psychiatrist.

Paediatric, cardiology, ophthalmological, and paediatric neurological assessments were completed as required. All children received Pneumococcal Conjugate Vaccine (PCV 13) and Pneumococcal Polysaccharide Vaccine (PPSV 23) prior to surgery, in accordance with pre-operative immunisation guidelines.

HRCT was performed on a Toshiba Alexion 16-slice multidetector CT (MDCT) scanner using high-resolution bone algorithm acquisition parameters: collimation 0.6 mm, slice thickness 0.5 mm, 16-slice volume acquisition, kV 120, mA 200, matrix 512×512, scan FOV 32 cm, and display

FOV 9.6 cm. Patients were placed supine in neutral position. Raw isometric volumetric data were reconstructed in multiplanar reformation (axial, coronal, and sagittal planes). Axial datasets were acquired parallel to the lateral semicircular canal (LSCC), and coronal datasets were obtained perpendicular to the LSCC, each with 0.5 mm thickness and 0.5 mm inter-image distance. Radiation dose optimisation followed the ALARA (As Low As Reasonably Achievable) principle. Bony landmarks systematically evaluated included the mastoid process (size, pneumatisation type, emissary vein, Korner's septum), external auditory canal, middle ear (aeration, ossicles), sigmoid sinus, jugular bulb, internal carotid artery course, the cochlea (morphology, number of turns, scala chambers, modiolus, axis of basal turn), vestibule, semicircular canals, bony labyrinth, vestibular aqueduct (VA), IAC diameter, and facial nerve canal course and measurements.

MRI of the temporal bone with brain screening was performed on a 1.5 Tesla Siemens unit using an 8-channel head coil with the patient in neutral supine position. Intravenous midazolam sedation was administered as required. Heavily T2-weighted fast spin-echo axial 3D sequences for temporal bone evaluation were acquired (TR 5.5 ms, TE 1.7 ms/FR, FOV 16×16 cm, slice thickness 1.0 mm/-0.5 mm overlap, matrix 320×320, NEX 6.0).

Direct oblique parasagittal images perpendicular to the IAC plane were obtained to evaluate the facial and vestibulocochlear nerves bilaterally (TR 6.7 ms, TE 2.1 ms/FR, FOV 12 cm, and matrix 320, NEX 6.0). T2-weighted axial brain screening images (TE 102.9 ms, TR 4780 ms) and Maximum Intensity Projection (MIP) images of the cochlea were also acquired. CISS (Constructive Interference in Steady State) sequences were used for detailed nerve and vessel assessment. MRI parameters assessed included the vertical diameter of the VIII cranial nerve in the parasagittal view medial to the IAC fundus (normal range 1.19–1.61 mm; hypoplasia defined as <0.9 mm; aplasia as <0.6 mm), membranous labyrinth morphology, endolymphatic fluid signal, and integrity of the central auditory pathway.

Unilateral CI surgery was performed via the standard transmastoid posterior tympanotomy approach, with electrode array insertion into the scala tympani via the round window or, where indicated, via anteroinferior cochleostomy. Intraoperative findings were systematically documented and compared with pre-operative imaging reports. Post-operative follow-up was conducted for a minimum of three months, with audiological assessment of sound detection and speech discrimination at each visit. The side of implantation was decided by the CI team based predominantly on the radiological findings favouring the ear with a better-pneumatised mastoid, no major vascular anomaly, patent cochlea, and normal cochlear nerve diameter.

Data were tabulated in a structured proforma and analysed using descriptive statistics. Frequencies and percentages were calculated for all categorical radiological, audiological, intraoperative, and post-operative variables. Pre-operative and intraoperative findings were compared to assess the concordance rate of HRCT and MRI in predicting surgical anatomy. Statistical analysis was performed using SPSS version 21.0 (IBM Corp., USA).

Results

A total of 35 children (70 ears) were evaluated. The salient radiological, audiological, intraoperative, and post-operative findings are presented in the following tables.

Table 1: Demographic and Audiological Characteristics of the Study Population (n=35 children; 70 ears)

Parameter	Category	No. of Patients/Ears	Percentage (%)
Age Distribution	1–3 years	23 patients	66%
	4–6 years	12 patients	34%
Sex Distribution	Male	22 patients	63%
	Female	13 patients	37%
BOA (Right Ear)	Profound (>91 dB HL)	20 ears	57%
	Severe to Profound (71–90 dB HL)	15 ears	43%
BOA (Left Ear)	Profound (>91 dB HL)	16 ears	46%
	Severe to Profound (71–90 dB HL)	19 ears	54%
DPOAE	Absent (both ears)	35/35	100%
BERA (Right)	Profound	19 ears	54%
	Severe to Profound	16 ears	46%
BERA (Left)	Profound	15 ears	43%
	Severe to Profound	20 ears	57%

BOA: Behavioural Observation Audiometry; DPOAE: Distortion Product Oto-Acoustic Emissions; BERA: Brainstem Evoked Response Audiometry

The majority of patients (66%) were in the 1–3 year age group, reflecting early referral for pre-operative imaging and the importance of early intervention in paediatric SNHL. A slight male preponderance was noted (63%). Distortion product OAE was absent bilaterally in all patients, confirming outer hair cell dysfunction in every case. Impedance audiometry revealed Type A tympanograms (indicating normal middle ear) in 33/35 right ears and 32/35 left ears.

Table 2: HRCT Findings of the Mastoid Process, External Auditory Canal, Middle Ear, and Vascular Structures (n=70 ears)

Structure Evaluated	Finding	No. of Ears	Percentage (%)
Mastoid Process Size	Normal	62	89%
	Hypoplastic	8	11%
Mastoid Pneumatisation	Pneumatic	29	42%
	Diploic	16	23%
	Mixed	15	21%
	Sclerotic	10	14%
RMTB Thickness	Normal (2.4–5.4 mm)	44	63%
	Decreased	26	37%
Korner's Septum	Present	55	79%
	Absent	15	21%
Mastoid Emissary Vein	Present	68	97%
	Absent	2	3%
External Auditory Canal	Normal	67	96%
	Hypoplastic	1	1%
	Soft Tissue in EAC	2	3%
Middle Ear Aeration	Good	66	94%
	Soft Tissue Thickening	4	6%
Middle Ear Ossicles	Normal	70	100%
Sigmoid Sinus	Normal	69	99%
	Laterally Placed	1	1%
Jugular Bulb	Normal	51	73%
	High Riding	15	21%
	Dehiscent	4	6%
Internal Carotid Artery	Normal	70 (all)	100%
Low Lying Dura	Present	2	3%
	Not Present	68	97%

RMTB: Retromastoid Temporal Bone; EAC: External Auditory Canal. Total ears evaluated = 70.

Mastoid pneumatisation type was the most commonly encountered radiological variable. Pneumatic (cellular) type, which carries the most favourable prognosis for CI surgery due to adequate working space and reduced intraoperative haemorrhage, was the most prevalent pattern (42%). Sclerotic mastoid was observed in 14% of ears and is associated with difficulty in identifying the facial nerve and short process of the incus. Mastoid emissary veins were present in 97% of ears—a finding of direct surgical significance, as their presence predisposes to significant intraoperative bleeding during drilling for the receiver-stimulator well. Korner's septum was present in 79% of ears, underscoring the importance of its pre-operative documentation to prevent the surgeon from being misled into the squamous rather than the petrous mastoid. A high-riding jugular bulb was identified in 21% and a dehiscent jugular bulb in 6% of ears, both of which increase the risk of intraoperative vascular injury and may restrict the surgical working field.

Table 3: HRCT Findings of the Cochlea, Labyrinth, IAC, and Facial Nerve Canal (n=70 ears)

Parameter	Finding	No. of Ears	Percentage (%)
Cochlear Morphology	Normal	67	96%
	Abnormal (dysplasia)	3	4%
Number of Cochlear Turns	2.5 turns (normal)	67	96%
	1.5 turns (Mondini)	2	3%
	No turns (aplasia)	1	1%
Axis of Basal Turn re: ICA	Parallel (normal)	67	96%
	Not Parallel	2	3%

	Absent (no cochlea)	1	1%
Modiolus	Present	66	94%
	Absent	4	6%
Scala Chambers	Symmetrical	67	96%
	Absent/abnormal	3	4%
Vestibule	Normal	67	96%
	Dilated	3	4%
Semicircular Canals	Normal	69	99%
	Dilated	1	1%
Bony Labyrinth	Normal	67	96%
	Abnormal	3	4%
Vestibular Aqueduct	Normal	68	97%
	Dilated (>1.5 mm)	2	3%
IAC Diameter	Normal (2–8 mm)	70	100%
Facial Nerve (to Recess)	Normal	58	83%
	Abnormal	12	17%
Facial Nerve (to Rd Window)	Normal	59	84%
	Abnormal	11	16%

IAC: Internal Auditory Canal; ICA: Internal Carotid Artery; Rd Window: Round Window. Abnormal facial nerve course includes anteriorly placed vertical/mastoid segment.

Cochlear morphology was normal in 96% of ears. Three ears in two patients exhibited cochlear dysplasia: two ears with Mondini's dysplasia (1.5 cochlear turns, Incomplete Partition Type II) and one ear with Incomplete Partition Type I (no cochlear turns, cystic cochlear appearance). The modiolus was absent in four ears (6%), all corresponding to the dysplastic cochleae. Dilated vestibule was seen in three ears, all co-existing with cochlear dysplasia. Vestibular aqueduct dilatation (>1.5 mm) was noted in two ears, both associated with Mondini's dysplasia. IAC diameter was within the normal range (2–8 mm) in all 70 ears, though MRI demonstrated cochlear nerve abnormalities (see Table 4). The facial nerve course was aberrant in 12 ears (17%) up to the facial recess and 11 ears (16%) up to the round window, most commonly as anteriorly placed mastoid segments—a finding critical for avoiding intraoperative facial nerve injury.

Table 4: MRI Findings and Intraoperative/Post-operative Outcomes (n=35 patients; 70 ears)

Parameter	Finding	No.	Percentage (%)
VIII Nerve (Vertical Diameter)	Normal (1.19–1.61 mm)	58 ears	83%
	Hypoplastic (<0.9 mm)	1 ear	1%
	Aplastic (<0.6 mm)	1 ear	1%
	Widened Nerve Canal	1 ear	1%
	Total Abnormal	9 ears	14%
Central Auditory Pathway	Intact	70 ears	100%
Membranous Labyrinth	Normal	68 ears	97%
	Abnormal	2 ears	3%
Endolymphatic Fluid	Normal	68 ears	97%
	Dilated	2 ears	3%
Pre-op vs Intra-op Concordance	Same (concordant)	32 patients	91%
	Discordant	3 patients	9%
Intraoperative Complications	Nil	29 patients	82%
	Emissary Vein Bleed	3 patients	9%
	Difficult Surgery (anatomical)	3 patients	9%
Post-op Sound Detection	Good	33 patients	94%
	Poor	2 patients	6%
Post-op Speech Discrimination	Good	30 patients	85%
	Slow	2 patients	6%
	Poor	3 patients	9%

VIII nerve diameter measured in parasagittal MRI view just medial to IAC fundus. Post-operative follow-up period: 3 months minimum.

MRI demonstrated a normal VIII nerve in 83% of evaluated ears. Hypoplastic and aplastic cochlear nerve were each noted in one ear (1% each), and widened cochlear nerve canal was observed in one ear.

Notably, the central auditory pathway was intact in all 35 patients on brain screening MRI, making central pathway lesions a non-contributory factor in this cohort. Membranous labyrinth and endolymphatic fluid were abnormal in three ears (corresponding to the two cases of cochlear dysplasia). The overall concordance rate between pre-operative radiological findings and intraoperative observations was 91%.

In three discordant cases, the discrepancy related to anteriorly placed facial nerve segments (two cases, not detected radiologically) and labyrinthitis ossificans at the round window level (one case, not detected pre-operatively on imaging but encountered intraoperatively).

Table 5: Summary of Clinically Significant Radiological Findings and Associated Surgical/Post-operative Events (n=35 patients)

Radiological Finding	No. of Cases (Ears)	Surgical Implication	Associated Complication
High Riding Jugular Bulb	15 ears (21%)	Restricted posterior tympanotomy field	Difficult surgery in 1 case (Case 17)
Dehiscent Jugular Bulb	4 ears (6%)	Risk of vascular injury at round window	Difficult approach (anticipated)
Mastoid Emissary Vein (bilateral)	68 ears (97%)	Intra-op bleeding during well drilling	Emissary vein bleed in 3 cases
Sclerotic Mastoid	10 ears (14%)	Facial nerve identification difficulty	Device failure (Case 33)
Mondini's Dysplasia (Bilateral)	2 patients (4 ears)	Modified cochleostomy, tight closure	Sub-acute wound infection (Case 17)
Incomplete Partition Type I	1 patient (1 ear)	Cystic cochlea; complex electrode insertion	Device failure on day 24 (Case 16)
Anteriorly Placed Facial Nerve	2 cases (intraop only)	Restricted round window access	Difficult cochleostomy step
Labyrinthitis Ossificans (intraop)	1 case	Drilling required for electrode passage	Device failure at 2 months (Case 27)
Abnormal VIII Nerve (MRI)	9 ears (14%)	Potential suboptimal nerve stimulation	Poor speech discrimination (3 cases)
Post-op Device Failure (any cause)	3 cases (9%)	Re-mapping and re-insertion planned	Incomplete audiological outcome

Cases 16, 17, and 27 represent the three most surgically complex cases in the cohort. Labyrinthitis ossificans (Case 27) was not detected on pre-operative imaging, highlighting the complementary role of intraoperative decision-making.

Discussion

Pre-operative radiological evaluation with HRCT and MRI is an established cornerstone of the multidisciplinary cochlear implant work-up. [1,2] The present study confirms the complementary and indispensable role of these two modalities in the paediatric CI population presenting to a tertiary care institution in South India, and provides a detailed radiological profile of the temporal bone findings and their clinical correlates.

The age distribution in this cohort—with 66% of patients below three years of age—reflects growing awareness among clinicians of the critical period for auditory cortical development. Sharma et al. demonstrated that the optimal period for CI surgery is before two years of age to achieve outcomes comparable to normal-hearing children. [8] A slight male preponderance (63%) was noted, consistent with the reported higher prevalence of congenital SNHL in males in the literature.

Among CT findings, the pattern of mastoid pneumatisation was the single most variable finding, with pneumatic type in 42%, diploic in 23%, mixed in 21%, and sclerotic in 14%. This distribution mirrors that of Alam Eldeen et al. [17] and Trimble et al. [6] The surgical significance of mastoid type is well established: sclerotic mastoids are associated with intraoperative difficulty in facial nerve identification and accessing the posterior tympanotomy site, as evidenced in our cohort where Case 33 (sclerotic mastoid with middle ear soft tissue thickening) had post-operative device failure. Mastoid emissary vein was identified in 97% of ears, a higher prevalence than most published series. This finding has direct surgical significance as its presence predisposes to significant intraoperative haemorrhage during drilling of the receiver-stimulator bony well, as demonstrated by intraoperative emissary vein bleeding in three of our patients. Phelps et al. [3] emphasised the importance of documenting this finding pre-operatively. Korner's septum was present in 79% of ears, consistent with published literature, and its pre-operative documentation is essential to prevent the surgeon from inadvertently entering the squamous air cells rather than the deeper petrous mastoid.

The jugular bulb was anomalous in 27% of ears (high-riding in 21%, dehiscent in 6%). This rate is slightly higher than the 20–25% reported in global literature. [9,12] Dehiscent jugular bulb poses a risk of catastrophic haemorrhage if unrecognised, and high-riding jugular bulb restricts access to the posterior tympanotomy site. In Case 17 (Mondini's dysplasia with high-riding jugular bulb), the pre-operative HRCT finding enabled the surgeon to anticipate and navigate the restricted field, though the procedure duration was prolonged. These findings underscore the direct surgical benefit of pre-operative HRCT in vascular risk identification.

Cochlear morphology was abnormal in only 4% of ears, with two cases of Mondini's dysplasia (Incomplete Partition Type II, characterised by 1.5 cochlear turns, absent interscalar septum between middle and apical turns, dilated vestibule, and dilated vestibular aqueduct) and one case of Incomplete Partition Type I (cystic cochlea without any internal architecture). Jackler's classification provides a well-established embryogenesis-based framework for categorising these malformations. [11] In Mondini's dysplasia, HRCT and MRI together are essential for surgical planning, including the choice of modified electrode insertion technique, the requirement for tight cochleostomy closure to prevent perilymph gusher, and the surgical team's preparedness for encountered CSF leakage.

MRI demonstrated an abnormal VIII nerve in 14% of ears, with the spectrum including hypoplasia, aplasia, and widened nerve canal. This is broadly consistent with the findings of Joshi et al. [14] and Jayaseak et al. [16] who underlined the primacy of MRI in defining cochlear nerve status, a parameter that cannot be assessed on CT. The three patients with post-operative poor speech discrimination all had VIII nerve abnormalities on MRI, reinforcing the predictive value of this finding for long-term audiological outcomes. The central auditory pathway was intact in all patients—an important finding as central pathway lesions represent a relative contraindication to CI, as they may limit the benefit of peripheral auditory stimulation.

The pre-operative to intraoperative concordance rate of 91% in this series is comparable to that reported by Seidman et al. [18] and reflects the diagnostic accuracy of the dual-modality imaging protocol. The three discordant cases (two with anteriorly placed facial nerve and one with labyrinthitis ossificans not detected pre-operatively) highlight the inherent limitations of imaging resolution at the 0.5 mm slice thickness used. For cases in which the round window approach may be restricted, the use of thinner sections or CISS MRI sequences may improve detection of early membranous ossification. [4,5] The three cases of post-operative device failure underscore the multifactorial nature of CI outcomes: while pre-operative imaging can identify most anatomical risk factors, complete radiological prediction of device performance remains elusive.

The overall post-operative outcomes were favourable: good sound detection was achieved in 94% and satisfactory speech discrimination in 85% of patients at the three-month follow-up. These results are consistent with published global outcomes for paediatric CI, which report open-set speech recognition rates of 70–90% in optimally selected candidates. [8] The two cases with poor functional outcomes corresponded to the most complex radiological phenotypes (Incomplete Partition Type I and labyrinthitis ossificans), confirming that radiological identification of these features should prompt the surgical team to counsel families about potentially guarded outcomes.

Conclusion

Pre-operative HRCT and MRI of the temporal bone are complementary, non-redundant imaging modalities that are essential in the evaluation of every paediatric cochlear implant candidate. HRCT characterises the bony labyrinthine anatomy, identifies vascular anomalies and surgical landmarks, and determines the pattern of mastoid pneumatisation and cochlear morphology. MRI confirms cochlear fluid patency, defines the vestibulocochlear nerve status, and assesses the central auditory pathway—information that HRCT is unable to provide. Together, these two modalities inform the choice of implant ear, anticipated surgical difficulty, appropriate electrode type, and realistic counselling of families regarding post-operative prognosis.

Radiologists must adopt a structured, systematic approach to reporting temporal bone imaging in CI candidates, ensuring that every surgically relevant finding—including variant vascular anatomy, facial nerve course, cochlear malformations, VIII nerve calibre, and membranous labyrinth signal—is explicitly documented. The 91% pre-operative to intraoperative concordance rate in this study validates the clinical utility of the dual-modality imaging protocol. Early pre-operative imaging and prompt CI surgery, ideally before the age of two, remain the cornerstones of audiological rehabilitation, enabling timely restoration of hearing, speech development, and normal social integration for children with bilateral profound SNHL.

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