VOLUME - 15, ISSUE - 07, JULY - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Radio-Diagnosis

HIGH-RESOLUTION CT-BASED MORPHOMETRIC EVALUATION OF THE INTERNAL AUDITORY CANAL

Dr. M Vaibhav Krishna	Post Graduate, Dept. of Radio-diagnosis
Dr. Adarsh A D	Professor, Dept. of Radio-diagnosis
Dr. Guru Yogendra	Senior Resident, Dept. of Radio-diagnosis
Dr. Usha Rani N J	Assistant Professor, Dept. of Radio-diagnosis
Dr. Siva Sidhanth Y	Senior Resident, Dept. of Radio-diagnosis
Dr. P Padma Priyanka	Senior Resident, Dept. of Radio-diagnosis
Dr. N Satya Sai Ram	Senior Resident, Dept. of ENT.

ABSTRACT **Background:** Quantitative IAC morphometry is relevant for imaging interpretation and surgical planning, and published data demonstrate meaningful variation in canal shape and dimensions. **Objectives:** Measure IAC morphometric dimensions on HRCT temporal bone. Establish normative reference values for the study population. **Methods:** A morphometric analysis of the IAC was conducted at Sri Devaraja Urs Medical College in Kolar, Karnataka, India, from November 2025 to May 2026. The study included subjects who underwent high resolution computed tomography (CT) of temporal bone. The scans were performed using a SIEMENS 128 slice – SOMATOM GO TOP system. The study measured the IAC opening width, longitudinal length from the opening to the end of the canal along its axis (LL), AP diameter of the length of the canal in both male and female subjects. **Results:** Of the 70 cases included in the study, 33 were female, and 37 were male. Three distinct shapes of the IAC were identified across both genders: cylindrical, funnel-shaped, and bud-shaped. Among the 70 samples, 35 exhibited a cylindrical shape, 27 were funnel-shaped, and 8 were bud-shaped. The mean opening width was 7.3 ± 0.18 mm in males and 7.2 ± 0.16 mm in females. The mean longitudinal length measured 9.97 ± 0.25 mm in males and 9.92 ± 0.21 mm in females. The mean AP diameter measured 4.47 ± 0.12 mm in males and 4.35 ± 0.10 mm in females.

KEYWORDS : Internal Auditory Canal; High-Resolution CT; Temporal Bone; Morphometry; Fundus.

INTRODUCTION

The internal auditory canal (IAC) is a short osseous canal located within the petrous portion of the temporal bone that extends from the posterior cranial fossa to the fundus of the internal ear. It transmits the facial nerve (cranial nerve VII), vestibulocochlear nerve (cranial nerve VIII), labyrinthine artery, and accompanying venous structures. Precise knowledge of its anatomy is essential for radiologists, otologists, and neurosurgeons involved in the diagnosis and management of temporal bone and cerebellopontine angle pathologies. [1,4]

Morphological variations of the IAC have significant clinical implications. Congenital narrowing of the canal has been associated with cochlear nerve hypoplasia or aplasia and congenital sensorineural hearing loss, whereas widening may be observed in vestibular schwannoma, facial nerve schwannoma, meningioma, vascular malformations, and other skull-base lesions. Accurate morphometric evaluation therefore aids in distinguishing normal anatomical variants from pathological conditions. [3,4]

High-resolution computed tomography (HRCT) is considered the imaging modality of choice for evaluating the osseous anatomy of the temporal bone because of its excellent spatial resolution and ability to provide isotropic multiplanar reconstructions. HRCT enables accurate morphometric assessment of the IAC and serves as an indispensable tool in the evaluation of congenital anomalies, temporal bone trauma, cochlear implant planning, and skull-base surgery. [1,2]

Several studies have demonstrated that morphometric parameters of the IAC vary among different populations due to ethnic diversity, developmental variations, and differences in imaging techniques. Consequently, establishing normative data for individual populations is important for improving diagnostic accuracy and facilitating preoperative planning. [1,5]

Therefore, the present study was undertaken to evaluate the morphometric dimensions of the internal auditory canal using HRCT by measuring its opening width, longitudinal length, and anteroposterior diameter and to compare these measurements between male and female subjects.

MATERIALS AND METHODS

Study Design: A hospital-based observational cross-sectional study was conducted at Sri Devaraja Urs Medical College in Kolar, Karnataka, India, from November 2025 to May 2026 in the Department of Radiodiagnosis. The study was reviewed and approved by the Institutional Ethics Committee, Sri Devaraj Urs Medical College. All subjects provided informed consent prior to enrollment after a detailed discussion of the study intent, potential benefits, and confidentiality measures.

Study Population: Seventy subjects who underwent HRCT examination of the temporal bone and fulfilled the inclusion criteria were included in the study. The study population comprised 37 males (52.9%) and 33 females (47.1%), with an age range of 28–72 years.

Inclusion Criteria: Adults (≥18 years) undergoing HRCT temporal bone with normal temporal bone anatomy on HRCT and no radiologic evidence of congenital inner-ear anomalies, fractures, or space-occupying lesions involving the IAC; and HRCT images of sufficient quality with complete

IAC visualization in axial and coronal planes to permit accurate morphometric measurements.

Exclusion Criteria: Any pathology involving the IAC (e.g., vestibular schwannoma, meningioma, inflammatory lesions, metastasis); congenital or acquired temporal bone abnormalities (e.g., inner ear malformations, otosclerosis involving the otic capsule, temporal bone fractures); and prior otologic/skull-base surgery that could alter IAC anatomy.

Imaging Technique: All subjects underwent HRCT of the temporal bone using thin-section multidetector CT. Images were reconstructed with a high-resolution bone algorithm in axial sections with multiplanar reformations to facilitate accurate morphometric measurements of the internal auditory canal.

Morphometric Measurements:

The following parameters of the internal auditory canal were measured using electronic calipers on the workstation:

- Opening width (OW): The distance from the more concave part of the posterior lip of the IAC wall to the more medial border of its anterior wall was used for measuring the opening width of the IAC
- Longitudinal length (LL): measured from the canal opening to the fundus along its long axis.
- Anteroposterior (AP) diameter: A perpendicular straight line drawn from the midpoint of the IAC length uniting the anterior and posterior walls was used for measuring the AP diameter.

Morphologic Categorization: IAC shape on CT is classified into funnel-shaped, cylindrical, and bud-shaped categories, as commonly applied in CT morphometric literature describing IAC shape variability.

Statistical Analysis

Data were entered into Microsoft Excel 2010 and analysed statistically. Continuous variables were expressed as mean ± standard deviation (SD). Comparisons between male and female subjects were performed using the unpaired t-test. A P value <0.05 was considered statistically significant.

RESULTS

A total of 70 HRCT temporal bone examinations were analysed, including 37 males and 33 females. Among the 70 samples, 35 exhibited a cylindrical shape, 27 were funnel-shaped, and 8 were bud-shaped. The mean opening width was 7.3 ± 0.18 mm in males and 7.2 ± 0.16 mm in females. The mean longitudinal length measured 9.97 ± 0.25 mm in males and 9.92 ± 0.21 mm in females. The mean AP diameter measured 4.47 ± 0.12 mm in males and 4.35 ± 0.10 mm in females. Although males demonstrated slightly greater values, the difference was not statistically significant.

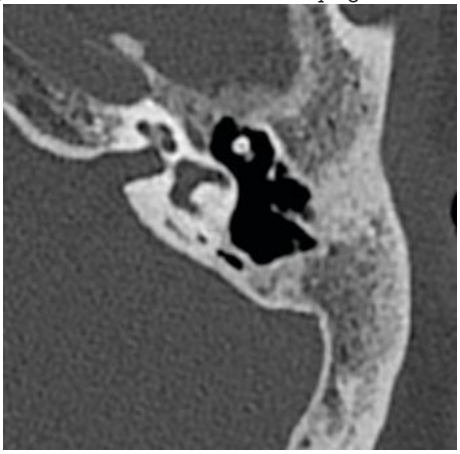

Figure 1: Computed Tomography Image Showing the Cylindrical Shape of the Internal Acoustic Meatus

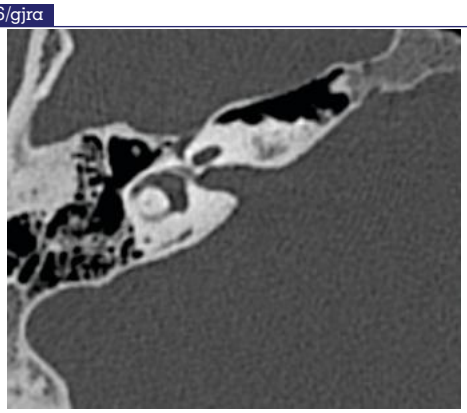

Figure 2: Computed Tomography Image Showing the Bud Shape of the Internal Acoustic Meatus

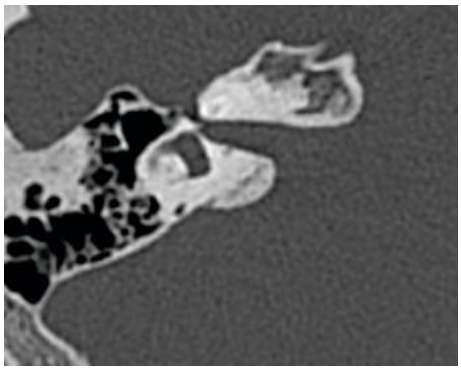

Figure 3: Computed Tomography Image Showing the Funnel Shape of the Internal Acoustic Meatus

Table 1. Morphometric Measurements of the Internal Auditory Canal

Parameter (mm)	Male (Mean±SD)	Female (Mean±SD)
Opening width	7.3 ± 0.18 mm	7.2 ± 0.16 mm
Longitudinal length	9.97 ± 0.25 mm	9.92 ± 0.21 mm
AP diameter	4.47 ± 0.12 mm	4.35 ± 0.10 mm

Table 2: Different Shapes of the Internal Auditory Canal in Both Males and Females

Gender	Cylindrical	Funnel	Bud
Male	19	13	5
Female	16	14	3

DISCUSSION

The internal auditory canal is an anatomically important osseous structure that houses the facial and vestibulocochlear nerves. Morphometric evaluation of the canal has gained increasing importance because abnormalities in its dimensions are associated with congenital hearing loss, cochlear nerve deficiency, vestibular schwannoma, and other skull-base disorders. [3,4]

In the present study, the opening width of the internal auditory canal did not differ significantly between male and female subjects. Similarly, although males demonstrated slightly greater longitudinal length and AP diameter than females, these differences did not reach statistical significance.

Our observations are consistent with previous HRCT morphometric studies, which have reported only minimal sex-related differences in IAC dimensions. Marques et al. demonstrated that HRCT provides reliable morphometric assessment of the internal auditory canal and highlighted the importance of establishing population-specific reference values because of anatomical variability among different ethnic groups [1]. More recently, Song et al. also demonstrated developmental and morphometric variations of the internal auditory canal using three-dimensional CT, reinforcing the usefulness of high-resolution imaging for anatomical evaluation [2].

Olivares and Schuknecht provided one of the earliest histological descriptions of IAC width and emphasised the normal anatomical variability of the canal [4]. Similarly, Kobayashi and Zusho established normative radiographic measurements of the internal auditory meatus, which continue to serve as important reference standards in radiological practice [5].

The absence of statistically significant sex-related differences in our study suggests that normal anatomical variation of the IAC is not substantially influenced by sex within the studied population. Nevertheless, establishment of regional normative data remains important because previous studies have demonstrated inter-population variability in morphometric measurements [1,3].

High-resolution CT continues to be the preferred modality for assessment of temporal bone osseous anatomy because of its superior spatial resolution and multiplanar capabilities. Accurate morphometric assessment of the IAC is particularly valuable during preoperative evaluation for cochlear implantation, diagnosis of congenital cochlear nerve deficiency, and assessment of skull-base lesions [8,9].

Limitations

The present study was conducted at a single tertiary care centre with a relatively modest sample size. The study evaluated only osseous dimensions on HRCT without MRI correlation or assessment of cochlear nerve morphology. Future multicentric studies with larger populations and MRI correlation may further improve the understanding of normal IAC morphometry.

CONCLUSION

High-resolution CT provides reliable and reproducible morphometric evaluation of the internal auditory canal. In the present study, no statistically significant differences were observed between males and females with respect to opening width, longitudinal length, or anteroposterior diameter. These findings contribute normative HRCT morphometric data for the studied population and may assist radiologists and otologic surgeons in differentiating normal anatomical variation from pathological abnormalities during clinical evaluation and preoperative planning.

REFERENCES

1. Marques SR, Ajzen S, D'Ippolito G, Alonso L, Isotani S, Lederman H. Morphometric analysis of the internal auditory canal by computed tomography imaging. Iran J Radiol. 2012;9(2):71-78.
2. Song SW, Chang KH, Jun BC. Morphometric analysis of the internal auditory canal by developmental change using three-dimensional computed tomography. Surg Radiol Anat. 2025;47:4.
3. Bächinger D, Breitsprecher TM, Pscheidl A, et al. Internal auditory canal volume in normal and malformed inner ears. Eur Arch Otorhinolaryngol. 2023;280:2149-2154.
4. Olivares FP, Schuknecht HF. Width of the internal auditory canal: A histological study. Ann Otol Rhinol Laryngol. 1979;88(3 Pt 1):316-323.
5. Kobayashi H, Zusho H. Measurements of internal auditory meatus by polytomography. I. Normal subjects. Br J Radiol. 1987;60(711):209-214. Todd NW, Graw M, Dietzel M. "Lateral angle" of the internal auditory canal: Non-association with temporal bone pneumatization. J Forensic Sci. 2010;55(1):141-144.
6. Ionescu EC, Reynard P, Idriss SA, et al. The "Near"-Narrowed Internal Auditory Canal Syndrome in Adults: Clinical Aspects, Audio-Vestibular Findings, and Radiological Criteria for Diagnosis. J Clin Med. 2023;12(24):7580.
7. Ahuja AT, Yuen HY, Wong KT, Yue V, van Hasselt AC. Computed tomography imaging of the temporal bone: Normal anatomy. Clin Radiol. 2003;58(9):681-686.