International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2025: 7.089

Radiological Evaluation of Sacral Hiatus and its Clinical Significance

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Abstract: ***This retrospective observational study evaluated the anatomical features and radiological variations of the sacral hiatus using computed tomography in 100 patients who underwent CT abdomen and pelvis examinations between January and August 2025. The sacral hiatus serves as an important access point for caudal epidural anaesthesia, and its anatomical diversity can influence the safety and success of various clinical procedures. Sagittal and reconstructed images obtained from a 16-slice CT scanner were analysed to assess the shape, level of apex and base, length, transverse width, and anteroposterior diameter of the hiatus. The inverted U shape was the most common morphology, followed by inverted V, dumbbell, irregular, and absent hiatus. The apex was most frequently located at the S4 vertebral level, while the base was commonly found at S5. Most cases showed a hiatus length of 10 to 30 mm, a transverse width of 7 to 20 mm, and an anteroposterior diameter of 3 to 6 mm. The findings highlight considerable anatomical variability of the sacral hiatus and underline the value of pre-procedural imaging in improving the accuracy and safety of caudal epidural blocks and other interventions involving the sacral region.***

Keywords: Sacral hiatus, Computed tomography, Caudal epidural anaesthesia, Anatomical variation, Sacrum

1. Introduction

Sacrum: triangular, wedge-shaped bone formed by 5 fused vertebrae and forms the posterior wall of the pelvis. It provides stability by articulating with lumbar spine, iliac bones, and coccyx [1].

Sacral Hiatus
- Terminal opening of the sacral canal
- Formed due to non-fusion of lamina of 5th (sometimes 4th) sacral vertebra [2]
- Bordered by sacral cornua → key landmark for identification [2]

Clinical Importance of Sacral Hiatus:
- Entry point for caudal epidural anaesthesia (CEA) [2].
- Site for nerve blocks where selective sacral spread is needed.
- Used in Perineal surgeries, painless labour and pain management [2].

Why Radiological Evaluation?
- Anatomical variations of sacral hiatus are common
- Variants affect success of caudal blocks and surgical procedures
- Imaging (X-ray, CT, MRI, USG) helps in: Locating the hiatus accurately, Identifying variations and guiding procedures safely

This study was undertaken to evaluate the anatomy and variations of the sacral hiatus radiologically, as these directly influence the success and safety of caudal epidural anaesthesia and related clinical procedures [3]

2. Aims and Objectives

- To evaluate the anatomy and variations of the sacral hiatus using CT.
- To study the morphology and dimensions of the sacral hiatus.

3. Materials and Methodology

Study Type: Retrospective observational study conducted on patients who had CT abdomen & pelvis from January 1st 2025 to August 31St 2025

Study Site: MIMS Radio- Diagnosis department

Sample Size:100

Study Sample: Convenient sampling.

Inclusion Criteria: Patients who had undergone CT abdomen and pelvis (all ages and gender)

Exclusion Criteria: Patients with sacral masses, sacral fractures which distorted the normal anatomy.

Study Technique: GE 16 slice (sagittal and virtual reconstruction images)

Parameters assessed:

Non-metric parameters [1]:
- Shape of hiatus
- Level of apex of hiatus with respect to sacral vertebrae
- Level of base of hiatus with respect to sacral vertebrae

Metric parameters [1].

- Length of hiatus
- Anterio-posterior diameter at the apex
- Transverse width of hiatus at base

4. Results

- Our study was conducted on 100 patients, constituting 34 females and 66 males.
- Age wise distribution included 37 patients > 40 yrs, 15 % were<20 years.
- While coming to morphological variation 53% had an inverted U-shaped hiatus; 25% had inverted v shape; 11% had dumbell shape; 10% had irregular shape and 1% had absent hiatus.
- The apex was most commonly at S4 (56%), and the base at S5 (73%).
- Hiatus length ranged 10–30 mm in 69% of cases, transverse width 7–20 mm in 95%, and AP diameter 3–6 mm in 75%.

5. Discussion

1) The sacrum provides a reliable and effective route for blocks in surgeries involving the low lumbar and sacral dermatomes [2].
2) Caudal epidural block is a widely used technique for [2]:
   - Surgical anaesthesia in children
   - Chronic pain management in adults
   - Intraoperative analgesia (e.g., genitourinary surgery, labour pain)
3) The block is performed by inserting a needle through the sacral hiatus (SH) to access the sacral epidural space 1.
4) Success rate depends on accurate localization of the sacral hiatus 2.

Our study was conducted on 100 patients, constituting 34 females and 66 males. Age wise distribution included 37 patients > 40 yrs and 15 <20 years.

In our study, the length of the SH, ranged from 10mm-30mm seen in 69% of the cases. This coincided with study conducted by Nadeem G [5], where length of SH of 11mm -30mm was seen in 2/3rd (57 %) of their cases. But Sinha M B et al.,[6] found length of SH of 10.01mm -20mm in 44% of their cases.

In our study, transverse width at base ranged from 7-20 mm, seen in 95% of cases. This coincided with Study conducted by Trotter and Letterman [7] where transverse width at the base varied between 7–26 mm.

In our study, AP diameter of sacral canal ranged from 3-6mm seen in 75% cases and only 3% of cases showed <3mm. This coincided with study conducted by Vinod Kumar et al.[8] where AP diameter of sacral canal was < 2 mm in 1% of their cases. Trotter & Lanier [10] showed more than 5 mm in Whites and 6 mm in Negroes group while Sekiguchi et al.[11] study showed average of 6.0±1.9 mm.

6. Clinical Significance

- Patients with AP diameter of sacral hiatus <3mm may not be able to accommodate anything larger than 22 gauge needle, which is seen in 5% of population.
- The location of SH apex is important because if it is located at the level of S2 vertebrae, there is more chance of puncture of dural sac2, seen in 5% of patients in our study.
- The longer sacral hiatus, reduces length of sacral canal which increases the possibility of needle puncture of dural sac.
- Narrow SH width increases the risk of failed block and damages the adjacent structures.

7. Summary

- This retrospective CT-based study of 100 patients assessed the anatomy and variations of the sacral hiatus, which is the key entry point for caudal epidural anaesthesia.
- Key Findings:
- Inverted U-shape was the commonest morphology (53%)
- Apex most often at S4 (56%), base at S5 (73%)
- Most had hiatus length 10–30 mm, width 7–20 mm, AP diameter 3–6 mm

8. Conclusion

- Multiple variations in size, shape, and level of sacral hiatus were observed in this study.
- Knowledge of anatomical variations of sacral hiatus improves success of CEB
- Imaging can assist in detecting variations of sacral hiatus
- Further studies using Ultrasound in conjunction with anaesthetists may be beneficial to improve procedural outcome.

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Abbreviations:

- CT-Computed Tomography
- MRI-Magnetic Resonance Imaging
- USG-Ultrasonography
- CEA-Caudal Epidural Anaesthesia
- CEB- Caudal Epidural Block
- SH- Sacral Hiatus
- AP- Anteroposterior
- S2, S4, S5-Second, Fourth, Fifth Sacral Vertebra
- Mm-Millimetre