

**Original Article****Anatomical Study Of Sacral Hiatus In Dry Isolated Sacra**

Jadhav Mayuri\*, Ghorpade Vijay\*\*, Nikam Vasudha\*\*\*, Gune Anita\*\*\*\*, Patil Asha\*\*\*\*\*

\*Resident, Assistant Professor, \*\*\*Professor and Head, \*\*\*\*Lecturer, \*\*\*\*\*Professor  
Department of Anatomy, Dr. D. Y. Patil Medical College, Kolhapur, Maharashtra, India  
\*\*Lecturer, Terna Medical College, Nerul, Navi Mumbai, Maharashtra, India

DOI : 10.5455/jrmds.20142210

**ABSTRACT**

**Background:** Caudal epidural block is widely used as diagnostic as well as therapeutic tool in lumbar spinal disorders by orthopedic surgeons. Failure in block in 30-35 % cases is reported to be due to anatomical variations of sacral hiatus and surrounding structures.

**Aim:** To assess the anatomical variation of sacral hiatus with its other bony landmarks to improve reliability of caudal epidural block

**Material and Methods:** 118 dry human sacra of irrespective sex were studied for anatomical variation of sacral hiatus.

**Result:** In the present study, it was observed that most common shape of sacral hiatus is inverted U –shape followed by inverted V – shape, both composing almost 70 % of the total sacra. Other shapes like irregular, dumbbell and bifid contributing to rest of the 30%. Apex of sacral hiatus was commonly found at the level of fourth sacral vertebra.

**Conclusion:** Clear understanding of the normal anatomy of sacral hiatus and other structures may be one of the important key factors for successful caudal epidural block

**Keywords:** Sacral hiatus, caudal anaesthesia

**INTRODUCTION**

The Sacrum is a large triangular bone placed between two innominate bones and forms postero-superior wall of pelvic cavity. Five sacral vertebrae are fused to form sacrum [1].

The opening present at the caudal end of sacral canal is known as sacral hiatus. It is formed due to the failure of fusion of laminae of the fifth (occasionally 4th) sacral vertebra. It is located inferior to the 4th (or 3rd) fused sacral spines or lower end of median sacral crest. On the surface the hiatus lies about two inches above the hip of coccyx beneath the skin of natal cleft.

The sacral hiatus contains lower sacral and coccygeal nerve roots, filum terminale externa and fibrofatty tissue. In recent state the hiatus is covered by superficial posterior sacrococcygeal ligament which is

attached to the margins of the hiatus and the deep posterior sacro-coccygeal ligament attached to the floor of sacral hiatus. Sacral hiatus has been utilized for administration of epidural anaesthesia in obstetrics [2] practice for treatment and diagnosis.

Sacral hiatus has been utilized for administration of epidural anaesthesia in obstetrics as well as in orthopaedic [2] practice for transpedicular and lateral mass screw placement [3]. The reliability and success of caudal epidural anaesthesia depends upon anatomical variations of sacral hiatus.

**MATERIAL AND METHODS**

The present study was conducted on 118 dry human sacra collected from Department of Anatomy, Dr. D Y Patil Medical College, Kolhapur. Each sacrum was

studied for different features of sacral hiatus with regards to:

- Shape of hiatus
- Level of apex of hiatus
- Length of hiatus
- Anteroposterior diameter of sacral hiatus at the apex

The measurements were taken with the help of vernier caliper.

**RESULTS**

Out of 118 sacra studied, most common shape of the sacral hiatus observed was inverted 'U' (42.37%), followed by inverted 'V' (27.11%), irregular (16.10 %), dumbbell (12.71%) and bifid (1.69%) (Table 1).

**Table 1: Shape of sacral hiatus**

Sr No.	Shape of sacral hiatus	No.	Percentage
1	Inverted 'U'	50	42.37%
2	Inverted 'V'	32	27.11%
3	Irregular	19	16.10 %
4	Dumbbell	15	12.71%
5	Bifid	2	1.69%

**Table 2: Location of apex in relation to level of sacral vertebra**

Sr No.	Location of the apex	No	Percentage
1	Deficient dorsal wall	0	0%
2	S2	5	4.23 %
3	S3	42	35.59 %
4	S4	67	56.77 %
5	S5 or absent hiatus	4	3.38 %

In 56.77 % of sacra apex of sacral hiatus was located at the level of S4 and in 35.59% of sacra apex was located at S3 level and in 4.23% it was at S2 level (Table 2). In most of the sacra, length of sacral hiatus was varied between 11mm to 40mm with mean of 18.45mm (Table 3). The antero-posterior diameter of

sacral canal at apex of sacral hiatus was ranged from 1 mm to 14 mm with a mean of 4.88 mm (Table 4).

**Table 3: Length of the sacral hiatus measured from the apex to the midpoint of the base**

Sr No	Length of sacral hiatus In (mm)	No N=118	Percentage
1	0 to 10	13	11.01%
2	11 to 20	41	34.74 %
3	21 to 30	35	29.66 %
4	31 to 40	20	16.94 %
5	41 to 50	5	4.23 %
6	> 51	4	3.38%

**Table 4: Antero-posterior diameter of sacral canal at the level of apex**

Sr No	AP diameter of sacral canal (in mm)	No	percentage
1	0 to 3	6	5.08 %
2	4 to 6	84	71.18 %
3	7 to 9	26	22.03%
4	> 9	2	1.69%

**DISCUSSION**

Study on the variation in anatomical features of sacral hiatus and the dorsal wall of sacral canal is related with regards to its clinical application in caudal epidural anaesthesia. Authentic literature mentions the lower end of sacral canal is an arch shaped sacral hiatus. Sacral hiatus has a somewhat triangular outline when seen from the dorsal aspect. (Trotter et al 1944) [4], Vinod kumar et al (1992) [5] noted various shapes of sacral hiatus, most common being inverted V and inverted U in 76.23% sacra, 7.43% were dumbbell shaped. In the present study also the shapes of sacral hiatus were variable, most common shape was inverted 'U' (fig1) (42.37%) and inverted 'V' (fig2) (27.11%). In 12.71% its outline was like a dumbbell (fig4) while in 16.10% it was irregular (fig3). Bifid hiatus was seen in 1.69%.

**Fig 1. Inverted ‘U’ shape**



**Fig 2. Inverted ‘V’ shape**



**Fig 3. Irregular shape**



Complete agenesis of dorsal bony wall of sacral canal was reported by previous workers namely Trotter et al (1944) [4] 1.8% and Vinod Kumar et al (1992) [5] 1.49%, that was not reported in present study.

**Fig 4. Dumbbell shape**



In the present study the apex of sacral hiatus was seen most commonly (67%) at the level of 4<sup>th</sup> sacral vertebra. Authentic literature states that the apex of sacral hiatus is present at level of 4th sacral vertebra. Various studies have shown similar results namely Vinod Kumar et al (1992) [5] reported in his series that the apex of sacral hiatus was most commonly (76.23%) present against 4th sacral segment, Sekiguchi M et al (2004) [3] noted the apex of sacral hiatus at S4 level in 64% cases. Earlier studies Trotter et al (1944, 1947) [4,6] and Lanier et al (1944) [7] in their series have reported the mean level of apex of hiatus to be at lower third of 4th sacral vertebra. All studies including the present study noted that location of apex can vary from upper end of S2 to lower part of S5.

The length of hiatus varied from 11mm to 30mm in the present study. Vinod kumar et al (1992) [5] observed mean length of hiatus as 20 mm in males and 18.9 mm in females. Trotter et al [4] have reported hiatal length as 24.8 mm in American males and 19.8 mm in females. Similar results were noted by earlier studies of Trotter et al (1944) [4] in which the length of hiatus varied from 0- 60 mm with a mean of 22.5 mm and Lanier et al (1944), mean length of hiatus being 25.3±9 mm.

The antero-posterior diameter of sacral canal at apex of sacral hiatus is important as it should be sufficiently large to admit a needle. Various diameters lead to subcutaneous deposition of anesthetic drug. In the present study the antero-posterior diameter ranged from 1 mm to 14 mm with (a mean of 4.88 mm.) Mean diameters reported by various workers are similar Trotter et al (1944) [4], 5.3 mm (range of 0-11 mm), Lanier et al (1944) [7], 6.1 mm ±0.2 mm, Trotter et al (1947) [6], 5 mm in Whites and 6 mm in Negro groups,

Vinod Kumar et al (1992) [5], 4.8 mm and Sekiguchi M et al (2004) [3],  $6.0 \pm 1.9$  mm.

## CONCLUSION

The sacral hiatus has anatomical variations and understanding of these variations may improve the success of caudal epidural anaesthesia. In the present study, elongated hiatus and narrowing of the sacral canal at apex of sacral hiatus was found in a significant percentage, which should be kept in mind while giving caudal anaesthesia in Indian population.

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### Corresponding Author:

Dr. Jadhav Mayuri B.  
202, Shantikunj, plot no 154,  
Sector 21, Nerul (E),  
Navi Mumbai. 400706  
Email: mayoojadhav@yahoo.co.in

Date of Submission: 09/10/2013  
Date of Acceptance: 09/06/2014

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**How to cite this article:** Jadhav Mayuri, Nikam Vasudha, Ghorpade Vijay, Gune Anita, Patil Asha. Anatomical Study Of Sacral Hiatus In Dry Isolated Sacra. J Res Med Den Sci 2014;2(2):43-6.

**Source of Support:** None  
**Conflict of Interest:** None declared