

# A Study of Sacral Hiatus in Dry Human Sacra

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**Abstract:** This study was carried out on 270 dry human sacra in Gujarat state to know the anatomical variations of sacral hiatus. Various shapes of sacral hiatus were observed which included inverted U (41.5%), inverted V (27%), irregular (14.1%), dumbbell (13.3%) and bifid (1.5%). The apex of sacral hiatus was commonly found at the level of 4<sup>th</sup> sacral vertebra in 39.6%. The mean length of sacral hiatus was 22.8 mm. The mean anteroposterior diameter of sacral canal at the apex of sacral hiatus was 4.88 mm. Narrowing of sacral canal at the apex of sacral hiatus, diameter less than 3mm, was observed to be significantly high, (15.6%).

The knowledge of anatomical variations of sacral hiatus is significant while administration of caudal epidural anaesthesia and it may help to improve its success rate.

**Keywords:** Sacral hiatus, apex, caudal anaesthesia.

## Introduction:

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 4<sup>th</sup>) sacral vertebra. It is located inferior to the 4<sup>th</sup> (or 3<sup>rd</sup>) 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 (Peter L William et al 2000).

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 (Edward et al 1942) as well as in orthopedic practice for treatment and diagnosis, Sekiguchi M et al (2004).

The reliability and success of caudal epidural anaesthesia depends upon anatomical variations of sacral hiatus as observed by various authors (Sekiguchi M et al 2004, Trotter M et al 1945 and 1947, Vinod Kumar 1992).

The present study was undertaken to find out the anatomical variations of sacral hiatus in the state of Gujarat.

## Material and Methods:

The present study was conducted in the Department of Anatomy, BJ Medical College, Ahmedabad, Gujarat. 270 dry human sacra were collected from various medical institutions of Gujarat state. Each sacrum was studied for different features of sacral hiatus with regards to:

1. Shape of hiatus
2. Level of apex of hiatus
3. Level of base of hiatus
4. Length of hiatus – measured from apex to midpoint of the base
5. Anteroposterior diameter of sacral hiatus at the apex
6. Transverse width of sacral hiatus at the base – measured between the inner aspect of inferior limit

of sacral cornua.

The measurements were taken with the help of calliper, divider and steel measuring tape.

Observations were substantiated with photographs.

## Observations and Results :

**Table 1**  
**Shape of sacral hiatus (n = 270)**

S.No.	Shape	No	Percentage
1.	Inverted U	112	41.5%
2.	Inverted V	73	27.0%
3.	Irregular	38	14.1%
4.	Dumbbell	36	13.3%
5.	Bifid	04	1.5%

In 4 sacra there was complete agenesis of the dorsal bony wall of sacral canal (1.5%). In 2 sacra sacral hiatus was absent (0.7%). In one, the sacral hiatus was less than 6 mm (0.4%).

These seven sacra were excluded from the measurements as typical sacral hiatus was not present in them.

**Table 2**  
**Location of apex in relation to level of sacral vertebra (n = 263)**

S.No.	Location of Apex	No.	Percentage
1.	4 <sup>th</sup> sacral vertebra	147	55.9%
2.	3 <sup>rd</sup> sacral vertebra	98	37.3%
3.	5 <sup>th</sup> sacral vertebra	09	3.4%
4.	2 <sup>nd</sup> sacral vertebra	09	3.4%

**Table 3**  
**Location of base of hiatus in relation to sacral / coccygeal vertebra (n = 263)**

S.No.	Location of base	No.	Percentage
1.	5 <sup>th</sup> sacral vertebra	191	72.6%
2.	4 <sup>th</sup> sacral vertebra	29	11.1%
3.	Coccyx	43	16.3%

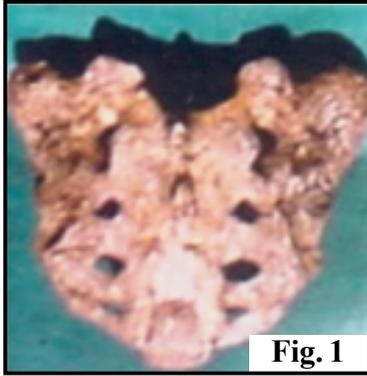


Fig. 1- Inverted U shaped sacral hiatus.

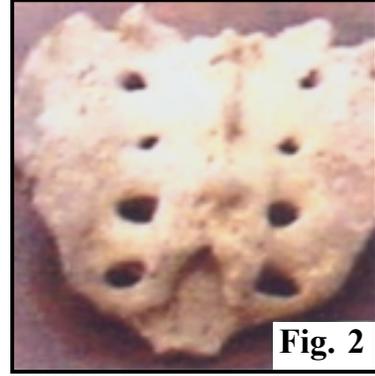


Fig. 2- Inverted V shaped sacral hiatus.



Fig. 3- Dumbbell shaped sacral hiatus

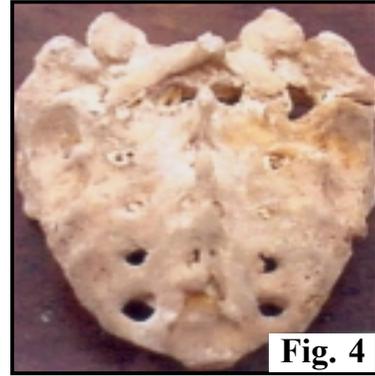


Fig. 4- Irregular shaped sacral hiatus.



Fig. 5- Bifid sacral hiatus.

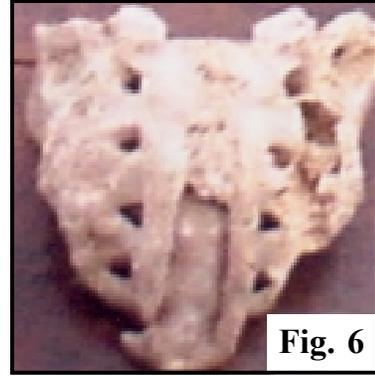


Fig. 6- Elongated sacral hiatus.



Fig. 7- Agenesis of dorsal wall of sacral canal

**Table 4**  
**Length of sacral hiatus from apex to midpoint of base (n = 263)**

S.No.	Length	No.	Percentage
1.	0-10 mm	27	10.3%
2.	11-20 mm	92	35.0%
3.	21-30 mm	81	30.8%
4.	31-40 mm	45	17.1%
5.	41-50 mm	13	4.9%
6.	> 51	05	1.9%

**Table 5**  
**Anteroposterior diameter of sacral canal at the level of apex (n = 263)**

S.No.	Diameter	No.	Percentage
1.	0-3 mm	4	15.6%
2.	4-6 mm	169	64.2%
3.	7-9 mm	52	19.8%
4.	Above 9 mm	1	0.4%

**Table 6**  
**Distance between the sacral cornua at base of sacral hiatus (n = 263)**

S.No.	Distance	No.	Percentage
1.	0-5 mm	21	8.0%
2.	6-10 mm	79	30.0%
3.	10-15 mm	142	54.0%
4.	Above 16 mm	21	8.0%

**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. Standard textbooks (Peter L. William et al, 2000) 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). Vinod kumar et al (1992) 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 inverted U (41.5%) and inverted V (27.0%). In 13.3% its outline was like a dumbbell while in 14.1% it was irregular. Bifid hiatus was seen in 1.5% which has not been reported in earlier studies.

There was complete agnesis of dorsal bony wall of sacral canal in 1.5% sacra of the present study. This is similar to that reported by previous workers namely Trotter et al (1944) 1.8% and Vinod Kumar et al (1992) 1.49%. In 0.7% of sacra in present study the hiatus was absent due to bony overgrowth which is similar to that reported by Vinod kumar et al (1992) in 0.99% where as in a study by Sekiguchi M et al (2004) it was absent in 3% cases.

In the present study the apex of sacral hiatus was seen most commonly (55.9%) at the level of 4<sup>th</sup> sacral vertebra. Standard textbooks (Peter L. William et al 2000) states that the apex of sacral hiatus is present at level of 4<sup>th</sup> sacral vertebra. Various studies have shown similar results namely Vinod Kumar et al (1992) reported in his series that the apex of sacral hiatus was most commonly (76.23%) present against 4<sup>th</sup> sacral segment, Sekiguchi M et al (2004) noted the apex of sacral hiatus at S4 level in 64% cases. Earlier studies Trotter et al (1944, 1947) and Lanier et al (1944) in their series have reported the mean level of apex of hiatus to be at lower third of 4<sup>th</sup> 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 base of sacral hiatus was seen at level of S5 vertebra in 72.6% sacra, similar to Vinod kumar et al (1992, 83.17%). It extended to coccyx in 16.3% cases. These sacra had coccygeal ankylosis.

The length of hiatus varied from 5mm to 6.9mm and in about 2/3 of sacra (65.8%), it was 11-30 mm in the present study. Vinod kumar et al (1992) observed mean length of hiatus as 20 mm in males and 18.9 mm in females. Trotter et al (1945) 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) 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 anteroposterior 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 anteroposterior diameter ranged from 2 mm to 14 mm with a mean of 4.88 mm. Mean diameters reported by various workers are similar Trotter et al (1944), 5.3 mm (range of 0-11 mm), Lanier et al (1944), 6.1 mm ±0.2 mm, Trotter et al (1947), 5 mm in Whites and 6 mm in Negro groups, Vinod Kumar et al (1992), 4.8 mm and Seikuguchi M et al (2004), 6.0 ± 1.9 mm.

In the present series sacra had anteroposterior diameter of sacral canal at apex of less than 3mm which is higher than the earlier studies namely Trotter et al (1947) who reported 5% cases with 0-2 mm diameter

and Trotter et al (1944) 4% sacra with diameter 0-2 mm while Lanier et al (1944) noted no case with diameter less than 3 mm.

The width at base of sacral hiatus varied from 0.3 to 19 mm, in more than half (54%) cases it was 10-15 mm and in 84% cases it was 6-15 mm. This was almost similar to earlier studies like Trotter et al (1944) who noted the width at base to vary from 7-26 mm with mean of 17 mm, Lanier et al (1944) who reported mean width at base to be  $19.3 \pm 0.3$  mm and Vinod Kumar et al (1992) who reported 5-20 mm (1.3 in mean) and 8-18 mm (1.25 mm mean) in male and female sacra of his series. Seikieguchi M et al (2004) have reported a lower figure of  $10.2 \pm 0.35$  mm. However, this may be because they noted the average distance between sacral cornua.

**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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