# A Morphological Study Of Sacral Hiatus In Dry Human Sacra And Its Clinical Importance

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**Abstracts**: Background & objectives: The opening at the inferior end of sacral canal is known as sacral hiatus.It formed due to the failure of fusion of laminae of the fifth (occasionally fourth) sacral vertebra. Sacrum is one of the bones which exhibit variations and the variation of sacral hiatus is of great clinical significance. Present study determined the landmarks for caudal epidural block (CEB) after morphometric measurements of the sacral hiatus on dry sacra bones .Methods: 120 sacral bones are used for the study. Anatomical measurements were measured by using Vernier caliper accuracy to 0.1mm. Results: Agenesis of sacral hiatus was detected in two sacral bones. Various shapes of sacral hiatus were observed which included inverted U (31%), inverted V (25.8%), irregular (20.6%), Elongated (17.2%) and dumbbell (5%). Apex of sacral hiatus was commonly found at the level of 4th sacral vertebra in 50.8%. The distance between the two superolateral sacral crests and the distance between the apex of sacral hiatus and the right and left super lateral crests were 69.5 (5.8) mm, 61.4 (11.2) mm, 57.4 (9.7) mm respectively, on average. The mean, mode, SD is calculated for all the measurements**.** Interpretation & conclusion: The sacral hiatus has anatomic variations. Understanding of these variations may improve the reliability of, caudal epidural block (CEB). [Satish P NJIRM 2016; 7(5):69-72]

**Key words:** sacrum, sacral hiatus, caudal epidural block (CEB)

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**Introduction:** The fusion of the posterior elements are not completed of the 5th or 4th sacral vertebra, results in the formation of sacral hiatus[1] .This inverted U shaped sacral hiatus is covered by the sacrococcygeal ligaments and forms an important landmark to perform caudal epidural block(CEB)[2]. The sacral hiatus is identified by palpation of the sacral cornua. Sacral cornua are felt at the upper end of the natal cleft 5 cm above the tip of the coccyx. Alternatively it may be identified by constructing an equilateral triangle based on a line joining the posterior superior iliac spines: the inferior apex of this triangle overlies the sacral hiatus. The sacral hiatus contains fifth sacral nerve, coccygeal nerve roots, filum terminale externa and fibro fatty tissue. In recent state the sacral hiatus is covered by superficial posterior sacrococcygeal ligament which is attached to the margins of the sacral hiatus and the deep posterior sacrococcygeal ligament to the floor of the sacral hiatus[3]. The sacral hiatus shows variations during itsdevelopment. Non -fusion of laminae of 4th or the upper vertebrae results in an elongated sacral hiatus. Non fusion of all the sacral vertebrae, results in sacral spina bifida. This leads to decreased surface area for the attachment of extensor muscle at the back; which may be a cause of backache [5].Sacral hiatus has been widely utilized for administration of epidural Sacral hiatus has been widely utilized for administration of epidural anaesthesia in obstetrics and surgery below the umbilicus such as hernia repair, Lower limb surgery, Skin grafting[4], the success rate CEB is depends on anatomic variations of sacral hiatus as observed by various authors. The present study was undertaken to find out the anatomical variations of sacral hiatus in dry human sacra found in India, Gujarat region.

**Methods:** The present study was conducted in the Department of Anatomy, GMERS Medical College Dharpur Patan, Gujarat. 120 dry human sacra were used for this study. The measurements were taken with the help of caliper, divider and steel measuring tape. Damaged, mutilated & deformed sacra were excluded. Each sacrum was observed for different features of sacral hiatus with regards to:

1. Shape of the sacral hiatus
2. Apex of the sacral hiatus
3. Base of the sacral hiatus
4. Length of the sacral hiatus
5. Transverse width of the sacral hiatus
6. Antero - Posterior width of the sacral hiatus

**Result:** Agenesis of the sacral hiatus was found in two sacrums. Various shapes of sacral hiatus are observed, inverted U (40%) shaped sacral hiatus is most commonly observed (Table-1) (Fig-3). The level of the apex of sacral hiatus in relation to sacral vertebra is observed and percentages are given in Table – 2. The level of the base of the sacral hiatus in relation to sacral/coccygeal vertebra is observed and percentages are given in Table-3.

**Table no.1 Shape of Sacral hiatus (n=120)**

| S. No | Shape | No | Percentage |
|---|---|---|---|
| 1 | Inverted U | 48 | 40% |
| 2 | Inverted V | 30 | 25.3% |
| 3 | Irregular | 21 | 17.3% |
| 4 | Elongated | 14 | 11% |
| 5 | Dumbbell | 7 | 6% |

**Table.2: Location of apex in relation to level of sacral vertebra(n=120)**

| S.No | Location of apex | No | Percentage% |
|---|---|---|---|
| 1 | 4$^{th}$sacral vertebra | 64 | 53.3% |
| 2 | 3$^{rd}$sacral vertebra | 44 | 37% |
| 3 | 5$^{th}$sacral vertebra | 7 | 5.4% |
| 4 | 2$^{nd}$sacral vertebra | 5 | 4% |

**Table.3: Location of base of hiatus in relation to level of sacral/coccygeal vertebra (n=120)**

| S.No | Location of base | No | Percentage% |
|---|---|---|---|
| 1 | 5$^{th}$ sacral | 76 | 64% |
| 2 | 4$^{th}$ sacral | 12 | 9.3% |
| 3 | Coccyx | 32 | 26.4% |

The average length of sacral hiatus was 28.5(13.7)mm (range 4-74mm). The length of sacral hiatus mostly between 4-29 mm. The average width of sacral hiatus (sacral cornua) was 12.5(4.1) mm (range 2-32 mm). The distance between the right superio lateral sacral crest and the sacral apex was 60.4(14.9) mm (range 40-90mm). The distance between the left superiolateral sacral crest and the sacral apex was 53.2(10) mm (range 38-75 mm). From the above mean values, it is important to know that the distance from the right and left sacral crests to the hiatus were similar in each sacrum. The anatomical measurements and statistical data are given in Table-4.

**Table.4: Morphometry of sacrum**

| | Mean | Median | SD | Max | Min |
|---|---|---|---|---|---|
| Length of the sacral hiatus(mm) | 28.5 | 23.7 | 13.7 | 74 | 4 |
| Width of sacral hiatus(sacral cornua) (mm) | 12.5 | 12 | 4.1 | 23 | 2 |
| Distance from apex to the the s2 foramina (mm) | 35.5 | 33.5 | 17.8 | 69 | 4 |
| Distance from base to s2 foramina(1+3)(mm) | 72.16 | 72 | 17 | 100 | 35 |
| Depth of SH at the level of its apex(mm) | 5.8 | 6 | 2.3 | 10 | 2 |
| Distance between two superolateral sacral crest(mm) | 59.3 | 56 | 10.8 | 89 | 45 |
| Distance between right supero lateral sacral crest & apex (mm) | 60.4 | 57 | 14.9 | 90 | 40 |
| Distance between left supero lateral sacral crest & apex (mm) | 53.2 | 52 | 10 | 75 | 38 |

**Fig.1:inverted "U" shaped sacral hiatus**


**Fig.2:inverted "V" shped sacral hiatus**

**Fig.3:Dumbled shaped sacral hiatus**

**Discussion:** Study on the anthropometric measurements of sacral hiatus and its anatomical features are related to its clinical application in caudal epidural anaesthesia. Standard textbooks (peterL.William et al, 2000)[6] 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). Ramamurthi et al (2013)[7,8] noted various shapes of sacral hiatus, most common being inverted U and inverted V. in the present study also the shapes of sacral hiatus were variable, most common inverted U (40%) and inverted V (25.3%). In 6% its outline was like a dumbbell, elongated 96%), while in 17.34 % it was irregular. The apex of sacral hiatus was seen most commonly (53.3 %) at the level of 4th sacral vertebra. Standard textbooks (peter L. William et al 2000) states that the apex of sacral hiatus present at level of 4th 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$^{th}$ sacral segment. Most of the authors including the present study noted that location of apex can vary from upper end of S2 to lower part of S5.

Base of the sacral hiatus was seen at the level of fifth sacral vertebra in 54% of sacra in the present study which was lower when compared to the study conducted by Ramamurthi KS[8] where he noted in 72.4% of sacra and much lower when compared to Vishal kumar et al[9] seen in 83.17% of sacra. It extended to coccyx in 26.4% cases. Due to anatomical variation caudal epidural space is always difficult to identify for clinicians. The apex of the sacral hiatus is an important bony point for caudal block but there may be difficulty in its palpation in some patients. Hence other bony landmarks should be used in relation with sacral hiatus; we can draw a triangle between the posterior superior iliac spines and the apex of sacral hiatus. We measure distance between such points which can guide clinician for detection of sacral hiatus easily and increase the success rate of caudal epiduaral block. William R.Meeker[10] and colleagues noted that the diameter of sacral canal is 4.5mm. It is difficult to pass the needle into the sacral hiatus if it cannot be located accurately.

Length of the sacral hiatus varied from 4 mm to 74 mm in the present study. The earlier workers namely Trotteretal[7] and Rajapur parashuram[11] reported that the length of sacral hiatus varied from 0 mm to 60mm and 4mm to 51mm respectively which was somewhat similar to present study. but high compared to the study values of Ramamurthi KS[8]. wher he got the values between 17mm to 49mm.

Ramamurthi KS[8] found the distance between the sacral cornua(16.2 (2.7) (10-22 mm) lesser than and the depth of sacral hiatus (5 (1.4) (2-7) mm) slightly greater than those measurements in our study (12.5 (4.1) (2-23) and 5.8 (2.3) (2-10) mm respectively). accommodate the needle. In the present study the depth ranged from 2-10mm with mean of 5.8(2.3)mm. mean depth reported by various authors are similar (Trotter et al, Lanier et al) to present study. The distance between the S2 foramen and the apex of the sacral hiatus was 35.5 (17.8) mm on average (range 4-69mm). The study by senoglu et al[12] and patil dhananjay[4] is similar to present studies. Additional measurements are distance between two superolateral sacral crest (base of the triangle) (59.3 (10.8) 45-89mm), distance between right superolateral sacral crest and sacral hiatus apex (60.4 (14.9) 40-90mm), distance between left superolateral sacral crest and sacral hiatus apex (53.2(10.0)38-75mm) forming nearly an equilateral triangle between superolateral sacral crest and sacral hiatus apex in most of the sacrums. This equilateral triangle can act as guide to the location of the apex of sacral hiatus during caudal epidural block and clinicians can avoid problem of failure in needle placement.

Our study is similar to the studies by Ramamurthi KS et al and patil dhananjay.

**Conclusion:** In the present study, elongated, dumbbell shaped hiatus and narrow space of the sacral canal at apex of sacral hiatus was found in a significant percentage. The anatomical study of sacral hiatus and knowing about anatomical variations of sacral hiatus is significant while administration of caudal epidural anaesthesia and measurements of sacral hiatus may improve its success rate.

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