Morphological and Morphometrical Study of Sacral Hiatus of Human Sacrum

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Abstract: Introduction: For successful epidural caudal anesthesia it is very important to know the anatomy of sacral hiatus. Caudal opening of sacral canal is sacral hiatus (SH).Methods: Eleven direct morphometric measurements were done on sacral vertebrae and hiatus of 56 adult dry human sacral bones of unknown age and gender. Morphological features shape, level of apex and base of SH were noted. Data were expressed as mean (SD), analysis were performed using SPSS. Results: Most common shape of SH was inverted 'U' in 34 (60.7%) sacrum. In 28 (50%) sacra apex was present at the level of S4. The level of base of sacral hiatus- in 46 (82.1%) sacra it was at S5 vertebrae. The length of SH was 21.73 ± 8.92mm, width was11.59 ± 3.25mm and the depth was 5.02 ± 2.09 mm. Distance from SH apex to S2 level was 30.30 ± 11.01 mm, from SH base to S2 level was 52.03 ± 6.54 mm and between upper border S1 and sacral apex was 59.58 ± 14.66 mm. The distance between the two superolateral crest was 61.16 ± 5.42 mm, between right superolateral crest and apex of SH was 57.54 ± 10.02 mm, the distance between left superolateral crest and apex of SH was 58.32 ± 10.59 mm, between the right superolateral crest and sacral apex was 86.22 ± 9.52 mm and between left superolateral crest and apex of sacral apex was 87.19 ± 9.85 mm. Conclusion: The given landmark in this study results in the formation of equilateral triangle, which can provide the practical benefit to the clinician for localization of SH in CEB. [A Singh, Natl J Integr Res Med, 2018; 9(4):65-73]

Key Words: Sacral Hiatus (SH), Caudal Epidural Block (CEB), Sacral Canal

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Introduction: Sicard and Cathelin introduced caudal anesthesia in1901, they injected local anesthetic agent through the sacral hiatus into the epidural space. It was the only means of epidural anesthesia until the lumbar epidural technique was described in 1921 by Page and in 1927 by Dogliotti. Because of variations in the anatomy of sacral hiatus, the use of caudal epidural block decline. Other reason for decrease use of this block is its dermatomal distribution of the nerve roots. In lumber epidural block the spread of anesthetic agent solution gives a wide dermatomal distribution of anesthesia because of superior and inferior spread of anesthetic agent while in caudal epidural block only cephalic distribution of the anesthetic agent occurs, so the less dermatomal segments are blocked[1].

For successful epidural caudal anesthesia it is very important to know the anatomy of sacral hiatus.Sacrum is a large triangular bone formed by fusion of five sacral vertebrae and forms the posterosuperior wall of the pelvic cavity, wedged between the two hip bones. Its caudal end articulates with the coccyx and superior wide base articulates with the 5th lumber vertebrae at the lumbosacral angle. Between the base and apex are dorsal, pelvic and lateral surfaces and a sacral canal. Dorsal surface is convex and the pelvic surface is concave. Pelvic surface is concave vertically and transversely. Four pairs of pelvic sacral foramina present on this surface and communicate with the sacral canal through the intervertebral foramina and transmit ventral rami of the upper four sacral spinal nerves. Dorsal surface of sacrum bears a raised interrupted median sacral crest with four (sometimes three) spinous tubercle which represent fused sacral spines. Below the 4th tubercle there is an arched sacral hiatus in posterior wall of sacral canal. This hiatus is produced by the failure of the lamina of the 5th sacral vertebrae to meet in the median plane. Flanking the median crest, the posterior surface is formed by fused laminas and lateral to this are four pairs of dorsal sacral foramina, they lead into the sacral canal through the intervertebral foramina and each transmit the dorsal ramus of a sacral spinal nerves. Medial to these foramina there is a row of four small tubercle which collectively known as intermediate sacral crest which represent fused articular processes of vertebrae. The inferior articular processes of the 5th sacral vertebrae are free and project downward and sides of the sacral hiatus as sacral cornua, connected to coccygeal cornua by intercornual ligament. Lateral surface is formed by fusion of transverse process and costal elements.

Sacral canal is formed by sacral vertebral foramina, triangular in section. Upper opening is seen on the basal surface. Its caudal opening is sacral hiatus. Sacral

canal contains cauda equine, filumterminale and spinal meninges. Thedural and arachnoid sheaths of spinal cord terminates at the level of S2 vertebrae (in adults at the lower border of S1 foramen and in children at the lower border of S3 foramen). The part of sacral canal below the S2 called caudal epidural space or caudal space, which is filled with coccygeal nerves, venous plexus, filum terminale and fats. This space is used for caudal epidural block for anesthesia and approach to it is through sacral hiatus[2]. Sacral hiatus is covered by skin, subcutaneous fatty layer and superficial sacrococcygeal ligament: attached to the margins of hiatus and in the floor of hiatus deep posterior sacrococcygeal ligament attached. Clinically sacral hiatus is identified by the palpation of sacral cornua, at the upper end of the natal cleft, 5 cm above the tip of coccyx when the patient is in lateral position or lying prone over a pelvic pillow.It is an important bony landmark for caudal epidural block. It contains the coccygeal nerve and filum terminale[2].

Anatomical variations of the sacral hiatus may be upward or downward displacement of sacral hiatus, absence of fusion of dorsal wall of sacrum (agenesis), and variations in shape of hiatus, depth of hiatus, narrowing or partial obliteration of sacral canal, ossification of sacrococcygeal membrane and asymmetric sacrum are either of traumatic or of pathological origin etc[3].

Sacral hiatus has been used for: 1) Analgesia and anesthesia in various clinical procedures, by injecting the drug in to the epidural space through the sacral hiatus such as surgeries below the umbilicus as in obs&gynae and hernia repair etc.[4]due to anatomic variations caudal epidural space is always difficult to identify for clinicians., 2) Thecaloscopy[5], 3) Trans-sacral endoscopy[5], 4) Myelography[6], 5) Caudal epidural injection of steroids/ pain killers as a therapeutic agents[7]and 6)Anterior epiduroscopic neural decompression: a minimally invasive spinal surgery[8].

The knowledge of anatomic variations of sacral hiatus may improve reliability of caudal epidural block. So the present study was conducted to find out the anatomical variations of sacral hiatus for caudal epidural block, with the help of morphometric measurements of the sacrum in relation to sacral hiatus in dry sacral bones.

Methods: Complete and undamaged 56 adult dry human sacral bones of unknown age and gender, obtained from the department of Anatomy and Forensic medicine of Rohilkhand Medical College and Hospital, Bareilly (U.P.) were used. Anatomical measurements were performed on these specimens using a Vernier caliper of accuracy of 0.01mm. Eleven direct morphometric measurement of importance for CEB, relating to sacral vertebrae and hiatus, were obtained. Total posterior closure and agenesis of dorsal wall cases excluded. Morphological features of sacral hiatus were noted as shape of hiatus, level of apex of sacral hiatus and level of base of sacral hiatus and following morphometric measurements were taken:

A. Height of sacral hiatus.
B. Width of sacral hiatus (distance between two sacral cornua).
C. Distance from the apex of sacral hiatus to the level of S2 foramen.
D. Distance from the base of sacral hiatus to the level of S2 foramen.
E. Distance between the upper border of S1 and sacral apex (length of sacral canal).
F. Depth of sacral hiatus at the level of its apex (anterioposterior diameter).
G. Distance between the two posterior superolateral crest.
H. Distance between right posterior suprolateral crest and apex of sacral hiatus.
I. Distance between left posterior superlateral crest and apex of sacral hiatus.
J. Distance between right posterior superolateral crest to sacral apex.
K. Distance between left posterior superolateral crest to sacral apex.

Since the posterior superior iliac spine of ilium, which is readily palpable on the body surface of patient, impose on the superolateral sacral crest of the sacrum; so the latter points were used as a landmark in these measurements. The line joins both right and left superolateral crests of sacrum forms the base of triangle and the line joining the apex of sacral hiatus to both right and left superolateral crests, forms the other two arms of the triangle. This triangle helps practically to detect the sacral hiatus.

Another triangle with the same base used, right arm of this triangle was the distance from the right

suprolateral crest and apex of sacrum and left arm was the distance from the left superolateral crest and apex of sacrum.

As the dural sac terminates around the level of S2 foramen; the distance between the apex of sacral hiatus to the level of S2 foramen and distance between bases of sacral hiatus to S2 foramen were also measured.

Statistical analysis: Data were expressed as mean (SD, Median), analysis were performed using SPSS.

Results: Agenesis of sacral hiatus in one sacrum and complete agenesis of dorsal wall of sacrum found in one sacrum were excluded from the study. Various shapes of sacral hiatus was observed, most commonest was inverted 'U' shaped in 34(60.7%) sacrum; in 14(25%) sacrum Inverted 'V' shaped; irregular sacral hiatus was present in 4(7%) sacrum; M shaped in 2(3.6%) sacrum and in remaining 2 (3.6%) sacra dumbbell shaped sacral hiatus was present out of total 56 sacra (Table:1).

The level of the apex of sacral hiatus in relation to sacral vertebrae was observed, in 28(50%) sacra apex was present at the level of S_4, in 24(42.9%)sacraapex was present at the level of S_3 and in remaining 4(7.1%) sacra apex was present at the level of S_2. The level of base of sacral hiatus in relation to sacral or coccygeal vertebrae was observed, in 46(82.1%) sacra level of base was S_5 vertebrae, in 8(14.3%) sacra level was S_4 and in remaining 2 (3.6%) level was at coccyx (Table:2).

The average length of sacral hiatus was 21.73± 8.92mm, average width of sacral hiatus at the level of sacral cornu was 11.59 ± 3.25mm and the depth of sacral hiatus at the level of apex was 5.02 ± 2.09 mm. Distance from SH apex to S2 level was 30.30 ± 11.01 mm, distance from SH base to S2 level was 52.03 ± 6.54 mm and distance between upper border S1 and sacral apex was 59.58 ± 14.66 mm. The distance between the two superolateral crest was 61.16± 5.42 mm, distance between right superolateral crest and apex of SH was 57.54 ±10.02 mm, the distance between left superolateral crest and apex of SH was 58.32 ± 10.59 mm, the distance between the right superolateral crest and sacral apex was 86.22 ± 9.52 mm and distance between left superlateral crest and apex of sacral apex was 87.19 + 9.85 mm (Table:5).
From the above mean value, it is important to know that the distance from the right and left sacral crests to hiatus were similar in each sacrum.

Table no. 1: shapes of sacral hiatus

Shapes	Frequency(n)	Percentage (%)
Inverted 'U'	34	60.7
Inverted 'V'	14	25.0
Irregular	4	7.1
M shaped	2	3.6
Dumbbell	2	3.6
Total	56	100

Table No. 2: Location of apex and base in relation to the level of sacral vertebrae

S.N.	Vertebral level	Location of Apex		Location of Base	
		Frequency (n)	Percentage	Frequency (n)	Percentage
1	5th sacral vertebrae	-	-	46	82.1
2	4th sacral vertebrae	28	50	8	14.3
3	3rd sacral vertebrae	24	42.9	-	-
4	2nd sacral vertebrae	4	7.1	-	-
5	coccyx	-	-	2	3.6

Table No.3: showing the results of different morphometric measurements.

Parameters	Mean	Std. Deviation	Std. Error of Mean	95% Confidence Interval		Median
				Lower	Upper	
Height of Sacral Hiatus(A)	21.73	8.92	1.19	19.40	24.07	20.21
Width of Sacral Hiatus (B)	11.59	3.25	.43	10.74	12.44	12.96
Distance from SH Apex to S2 level(C)	30.30	11.01	1.47	27.42	33.18	31.45
Distance from SH Base to S2 level(D)	52.03	6.54	.87	50.32	53.75	52.36

Distance b/w Upper Border S1 & SH Apex(E)	59.58	14.66	1.96	55.74	63.42	60.24
Depth of SH at apex level (F)	5.02	2.09	.28	4.47	5.56	4.80
Distance b/w two posterior superolateral crest (G)	61.16	5.42	.72	59.75	62.58	60.75
Distance b/w right posterior superolateral crest and apex of SH (H)	57.54	10.02	1.34	54.92	60.17	57.33
Distance b/w left posterior superolateral crest and apex of SH (I)	58.32	10.59	1.41	55.55	61.10	57.48
Distance b/w right posterior superolateral crest and sacral apex (J)	86.22	9.52	1.27	83.73	88.72	87.63
Distance b/w left posterior superolateral crest and sacral apex (K)	87.19	9.85	1.32	84.61	89.77	88.54

Table No.4: Comparison of Shapes of Sacral Hiatus by different authors

S.N.	Authors	Total number	Inverted'U' shape(%)	Inverted 'V' shape (%)	Irregular shape (%)
1	Osunwoke et al[14]	54	24.1	33.1	13
2	Vinod et al[15]		29.70	46.53	-
3	Nasr A Y et al[16]	150	31.33	38.66	15.33
4	Qudusia et al[13]	194	62.37	22.16	8.76
5	Deepa S et al[25]		57.5	25	17.5
6	Present study	56	60.7	25	7.1

Table 5: Level of apex & base of sacral hiatus reported by different authors

Authors	Total no. (N)	Level of Apex of Sacral Hiatus				Level of Base of Sacral Hiatus		
		S4	S3	S2	S5	S5	S4	Co
Nagar et al[17] (2004)	270	147 (55.9%)	98 (37.3%)	9 (3.4%)	9 (3.4%)	191 (72.6%)	29 (11.1%)	43 (16.3%)
Dipali Rani et al[18] (2012)	160	80 (50%)	72 (45%)	_	8 (5%)	132 (82.5%)	14 (8.7%)	14 (8.7%)
Rammurti KS et al[4] (2013)	116	59 (50.8%)	48 (41.3%)	9 (7.7%)	_	84 (72.4%)	22 (18.9%)	10 (8.6%)
Nasr A Y et al[16] (2014)	150	81 (54%)	22 (14.66)	2 (1.33%)	41 (27.33%)	105 (70%)	18 (12%)	27 (18%)
Present study(2015)	56	28 (50%)	24 (42.9%)	4 (7.1%)	_	46 (82.1%)	8 (14.3)	2 (3.6)

Table No.6: Height, Width and AP Diameters of sacral hiatus reported by different authors

Authors	Total numbers	Length of SH (mm)	Width of SH (mm)	AP diameter of SH(mm)
Senoglu et al[27] (2005)	96	32.1	17.47	4.46
Dipali Rani et al[18] (2012)	160	23.61 ±8.28	12.75 ± 2.92	5.34 ± 1.39
Lakshmi et al[31] (2013)	51	34.96 ± 12.9	14.8 ± 2.32	4.61± 1.5
Sanatnu B et al[32] (2013)	100	35.92 ± 3.75	9.79 ± 1.31	7.23 ± .71
Clarista MQ et al[19] (2013)	104	24.73 ± 9.38	16.87 ± 3.66	5.58 ± 1.39
Nasr A Y et al[16] (2014)	150	27.16 ± 1.29	11.50 ± 3.13	4.78 ± 1.68
Mishra M et al[21] (2014)	93	19.73	12.11	4.0
Present Study	56	21.73 ± 8.92	11.59 ± 3.25	5.02 ± 2.09

Table 7: Comparision of Depth (Diameter) of Sacral hiatus at its Apex

Authors	Total no. of patients or sacrum	Mean diameter (mm)
Blanchis et al[29] (by USG)	-	5.3 mm
Chen et al[11] (by USG)	-	6 mm
Crigton et al[30] (by MRI)	15	4.6 mm
Present study (2015)	56	5.02 ± 2.09 mm

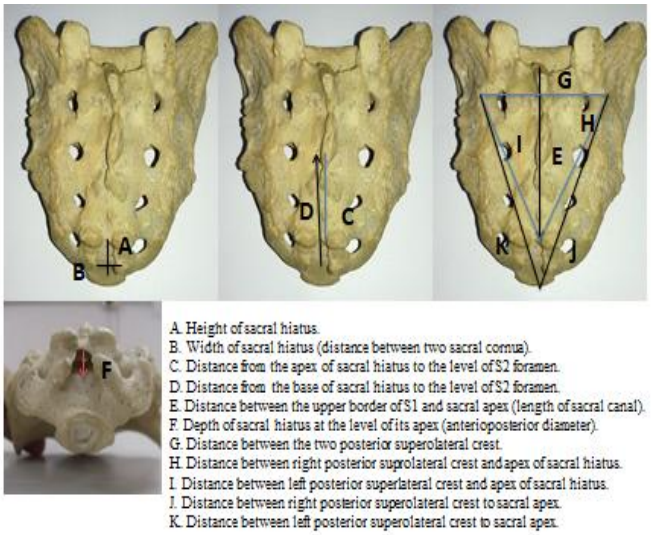
Table 8:Distance from apex of SH to S2 foramen (C)

Authors	Total Number	Mean distance(C) (mm) ± SD
Rammurti KS et al[4]	116	30.2 ± 10.5
Dipali Rani et al[18]	160	31.33 ± 10.59
Lakshmi et al[31]		31.53 ± 9.05
Mustafa MS et al[23]	46	41± 11.4
Santanu et al[32]	100	43.41± 8.5
Present study	56	30.30 ± 11.01

Table 9:Triangle between two Post Superolateral Crestand apex of sacral hiatus (EFG) reported by different authors

Authors (N)	Base (E) (mm) +SD	Right margin (F) (mm) + SD	Left margin (G) (mm) + SD	Type of triangle
Senoglu et al[27](2005)n=96	66.51 ± 53.52	67.10 ± 9.95	67.53 ± 9.48	equilateral triangle
Lakshmi et al[31](2013)n=51	61.51 ± 19.49	58.28 ± 9.36	58.54 ± 9.47	equilateral triangle
Sanatnu B et al[32](2013) n=100	64.77 ± 5.2 mm	58.41 ± 2.70	58.37 ± 2.76	isosceles triangle
Aggarwal et al[28](2009)n= 114	50.96 ± 6.69	59.92 ± 8.84	59.99 ± 8.31	Equilateral triangle -45% 55% cases both sides were much shorter than the base of the triangle.
Rammurti K S et al[4](2013)n= 116	69.5± 5.8	61.4± 11.2	57.4± 9.7	Isosceles triangle
S Deepa et al[25](2014)n=40	62.3±4.4	69±14.5	71±17.7	Isosceles triangle
Present study (2015)n=56	61.16 ± 5.42	57.54 ± 10.2	58.32 ± 10.59	equilateral triangle

Fig 1: digital Vernier caliper



A. Height of sacral hiatus.
B. Width of sacral hiatus (distance between two sacral cornua).
C. Distance from the apex of sacral hiatus to the level of S2 foramen.
D. Distance from the base of sacral hiatus to the level of S2 foramen.
E. Distance between the upper border of S1 and sacral apex (length of sacral canal).
F. Depth of sacral hiatus at the level of its apex (anterioposterior diameter).
G. Distance between the two posterior superolateral crest.
H. Distance between right posterior suprolateral crest and apex of sacral hiatus.
I. Distance between left posterior superlateral crest and apex of sacral hiatus.
J. Distance between right posterior superolateral crest to sacral apex.
K. Distance between left posterior superolateral crest to sacral apex.

Fig 2: Various measurement of sacral Hiatus & Sacrum

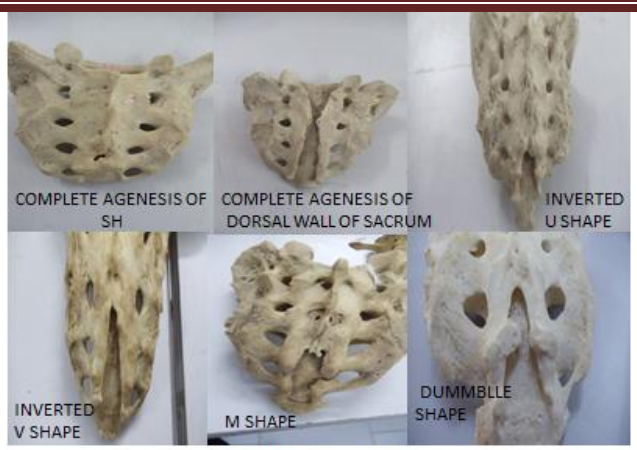


FIG 3: DIFFERENT SHAPES OF SACRAL HIATUS

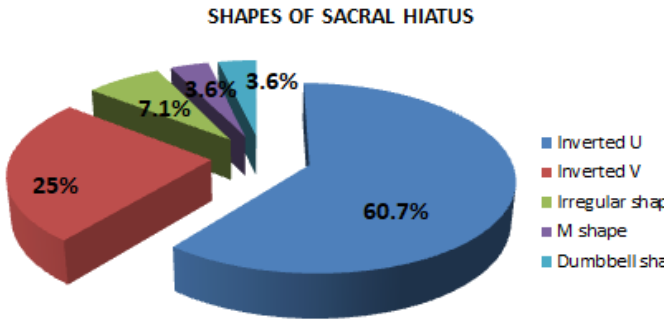


Chart 1: showing Percentage of Shapes of SH in present stuc

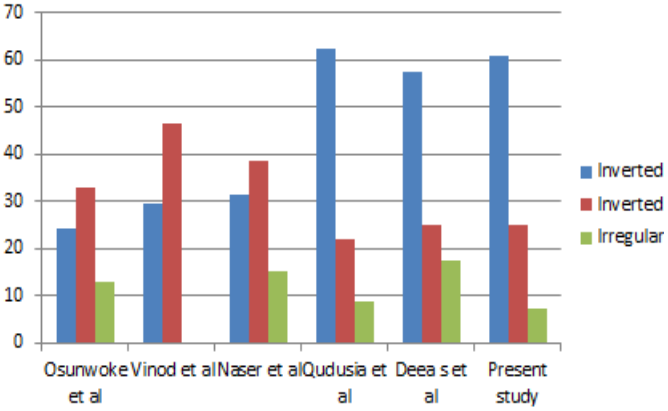


Chart 2: showing Shapes of SH reported by various Authors

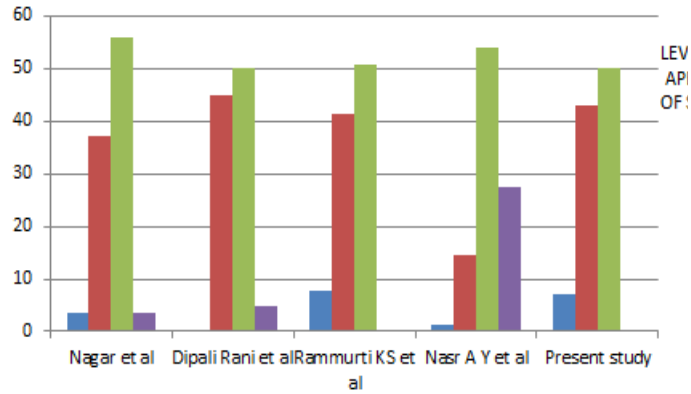


Chart 3: showing the Level of Apex of SH in various studies

Discussion: For successful sacral caudal epidural block, the knowledge of anatomical variations and structural modifications of sacral hiatus is necessary. Caudal epidural block is a technique of injecting medication in to epidural space via sacral hiatus. It is practiced since 1952 to anaesthetize lumber and sacral dermatomes and also for the symptomatic relief of low backache disorders in patients by injecting corticosteroids. Injecting technique used is prone position of patient,table is flexed or with pillow beneath the pelvis,followed by palpation of sacral cornu and hiatus with the help of left hand fingers. Needle is then inserted 2-3 mm at an angle of 45 degrees, 'pops'through the sacrococcygeal ligament[3]. A failure rate has been reported by some authors; in children 14.82% failure rate noted by Paolo Busoni et al[9]and in adults Shu-Yam Wong[10] reported a highest success rate 95.9%. Ultrasound guided needle placement success was 100% by Carl P. C. Chen[11]. The apex of the sacral hiatus is an important bony point for caudal epiduaral block but there may be difficulty in its palpation in some patients especially in obese. Hence other bony landmarks can also be used in relation with sacral hiatus. We can use a triangle which is drawn between the posterior superior iliac spines (superolateral sacral crest in dry sacral bones) and the apex of sacral hiatus. We measured the distance between these points which can guide the clinician for detection of sacral hiatus easily and increase the success rate of caudal epidural block. William R. Meeker[12] and colleagues noted that the diameter of sacral canal is 4.5mm and it is difficult to pass the needle into the sacral hiatus if it cannot be located accurately.

In present study the shape of sacral hiatus were variable and the most common being the inverted 'U' shaped in 34(60.7%) sacra, followed by inverted 'V' shaped in 14(25%) sacra and this was similar to Qudusia et al[13] (2014) in which they found the most common shape of sacral hiatus was the inverted 'U' shape in121(62.37%) sacra and inverted 'V' shaped in 43(22.16%) sacra but was not similar with the Osunuoki etal[14] and Vinod et al[15]. Vinod et al (1992) noted most common shape of sacral hiatus was inverted 'V' shape in 94(46.55%) sacra and inverted 'U' shape in 60(20.70%) and Osunuoki et al (2014) noted inverted 'V' shape in 18(33.3%) sacra followed by inverted 'U' shape in 13(24.1%) sacra.Nasr A Y et al[16] (2014) found most common shape inverted 'V'in

58(38.66%) sacra and inverted 'U'shape in 47(31.33%)Egyptiansacra.

In present study 2(3.6%) sacra was found to have its outline like dumbbell which was very low when compared with other studies as by Nagaret al[17] (2004) in 36(13.3%) sacra and Dipali Rani et al[18](2012) in20(12.5%) sacra. M shaped sacral hiatus was observed in 2(3.6%) sacra in this study which was similar with the study done by Clarista MQ et al[19] (2013) noted in 3(2.9%) sacra, while irregular shaped sacral hiatus was observed in 4(7.1%) sacra in present study which was similar with the Qudusia et al[13] (2014) noted in 17(8.76%) sacra.

In present study apex of the SH was most commonly found at the level of S_4 sacral vertebrae, in 28(50%), which was almost similar with the observations by Nagar et al[17] (2004) in 147 (55.9%), by Dipali Rani et al[18](2012) in 80(50%) ,by Rammurti KS et al[4] (2013) in 59(50.8%) sacra and by Nasr A Y et al[16] (2014) in 81(54%) sacra. The base of sacral hiatus was seen most commonly at the level of S5 vertebrae, in 46(82.1%) sacra in present study similar with the Dipali Rani et al[18](2012) in 132(82.5%) ,Manisha B Sinha et al[20](2014) in 55(88.7%) sacra and by Mishra M et al[21] (2014) in 79(89.77%) sacra.

The distance from the apex of the sacral hiatus to the midpoint of the base (distance between the two sacral cornu) was 21.73±8.92 in this study which was similar as found by Z K Patel et al[22] (2011) 19.63mm (range 4mm-57mm), by M S Mustafa et al[23] (2012) 21±8mm , by V Phalgunan et al[24] (2013) 21.13±12.74mm, by S Deepa et al[25] (2014) 21±11.44mm and by Mishra M et al[21] (2014) 19.73mm.

Cornua are palpable as a landmark on either side just below the apex of hiatus for localization of the sacral hiatus clinically. In the present study the distance between the two cornu was found to be 11.59±3.25 mm. Sekiguchi et al[26] (2004) noted 10.2±3.5mm, Senoglu et al[27](2005) noted 17.47±3.23mm, Aggarwal et al[28] (2009) noted 11.95±2.78mm, Blanchais et al[29](2010) noted 14.2mm, Nasr A Y et al[16] (2014) noted 11.5±3.1mm, Mishra M et al[21] (2014) noted 12.11mm and S Deepa et al[25] (2014) noted 12.2±4.57mm.

Diameter(anterio-posterior length of SH at the apex) of sacral hiatus is important because if it is <2mm, then there may be difficulty in the use of 22G needle for Caudal epidural space. In present study 10.7% sacra had AP diameter <2mm and lowest measured value was 1.48mm and the mean value was 5.02±2.09mm (given in table4). Similar observation were noted by Kumar et al[15] (1992) 4.8mm, by Nagar et al[17](2004) 4.8mm, by Sekiguchi et al[26](2004) 6mm, by Senoglu et al[27](2005)4.46mm, by Mishra Met al[21](2014) 4mm and by Nasr A Y et al[16](2014) 4.78±1.87mm in Egyptian sacra. AP diameter by ultrasonographic study was measured by Blanchiset al[29] and Chen et al[11] and found to be mean AP diameter 5.3mm and 6mm respectively. By MRI study done by Crigtonet al[30] AP diameter found to be 4.6 mm, which was similar to the present study. In present study minimum AP diameter was 1.48mm and maximum diameter was 9.62 mm.

Length of sacral canal is measured as vertical distance between the apex of SH and the upper border of the sacral canal; in present study it is found to be 59.58±14.66mm which is similar to that measured by Mourgella et al[5] using MRI 59.03mm. Patil et al[3](2012) noted 64.77±17.07 mm, Lakshmi et al[31] (2013) noted 60.41±13mm and Santanu et al[32](2013) noted 66.19±4.8mm.

As the dural sac ends at the level of S_2 vertebrae, the distance from the SH apex to S2 spine and distance from the base of SH to apex of S2 spine noted, because anaethetist or endoscopist must know that how far to push the needle or instrument into the sacral canal from the SH. In present study the distance between apex of SH to spine of S2 was found to be mean of 30.30±11.01mm. By other authors it was reported as RammurtiKSetal[4] (2013) 30.2±10.5mm, by Dipali Rani et al[18] (2012) 31.33±10.59 mm and by Lakshmi etal[31] (2013) 31.53±9.05mm which was similar with the present study. The distance between the base of SH and S2 spine was reported in present study was 52.03±6.54 mm and by other authors it was found to be as by Rammurti K S et al[4] (2013) 59.5±8.8mm, by Dipali Rani et al[18] (2012) 54.88±7.92mm which was similar with the present study but by Santanu et al[32](2013) and Phalgunan et al[24](2013) it was noted as 79.64±8.9mm and 60.23±17.97mm respectively which was little higher than present study.

A triangle formed between the two posterior superior iliac spines and the apex of SH, usedas an important landmark to locate the SH clinically. In this study this

triangle had almost equilateral features. The mean value of three sides of triangle i.e. base, right margin and left margin were 61.16±5.42mm, 57.54±10.2mm and 58.32±10.59mm respectively, these values are nearly equal and formed an equilateral triangle which is similar to other studies done by Senoglu et al[27] (2005) mean values of three sides were 66.51±53.52mm, 67.10±9.95mm and 67.53±9.48mm respectively and forming equilateral triangle. By Lakshmi etal[31](2013) the values were 61.51±19.49mm, 58.28±9.36mm and 58.54±9.47mm respectively, forming almost equilateral triangle. By Mustafa MS et al[23] (2012) these values were 75.5±10.3mm, 75±10.2mm and 75±10.2mm, forming equilateral triangle, but by some authors it was not found to be equilateral triangle as by Sanatnu B et al[32] (2013) it was an isosceles triangle and mean values were 64.77±5.2mm, 58.41±2.70mm and 58.37±2.76mm and by Aggarwal et al[28] (2009) reported mean values of three sides were 50.96±6.69mm, 59.92±8.84mm and 59.99±8.31mm respectively and found equilateral triangle only in 45% cases and in rest 55% cases both sides were much shorter than the base of the triangle.
Another triangle was also measured in this study with the same base as in previous triangle with the right margin was from the right suprolateral crest to apex of sacrum and the left margin from the left superolateral crest to the apex of the sacrum and the mean values of base, right margine and left margine were 61.16±5.42mm, 86.22±9.52mm and 87.19±9.85mm respectively. Same triangle was reported by Santanu B et al[32] (2013) and values were 64.77±5.2mm, 81.37±2.8mm and 81.41±2.4mm. These two triangles will help the clinician to locate the SH.

Conclusion: There are variabilities in the anatomical structure of SH.This may be due to genetic and racial factors.The given landmarks in this study,resulting the formation of equilateral triangle, which can provide the practical benefit to the clinician for localization of SH in CEB.Further clinical trials are required to compare the existing techniques and our anatomical description to support the result of this study.

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