

Anatomical variation of human sacral hiatus its morphometry and clinical importance in caudal epidural anaesthesia.

Dr. Ashish Khokhariya^{1*}, Dr. Hitesh Chauhan², Dr. Ashok Nirvan³, Dr. Sucheta Chaudhary⁴

¹Third Year Resident, ²Tutor, ³Associate Professor, ⁴Professor and Head, Department of Anatomy, B.J.Medical College, Ahmedabad, Gujarat, India.

Abstract:

Introduction: The sacrum is a bone which contributes to the formation of the pelvic girdle. It has piqued the interest of anatomists, forensic scientists and physicians, especially anaesthetists because of its unique value in gender estimation in medico-legal proceedings as well as the importance of its anatomical structure in relation to the technique of giving caudal anaesthesia. **Material & Method:-**This study was carried out on 200 dry human sacrum in Bone store of Anatomy Department, B.J Medical College, Ahmedabad, Gujarat. Parameters of sacral hiatus such as shape, level of apex and base, length, antero-posterior (AP) diameter at apex, and intercornual distance along with distance between supero-lateral sacral crests and their distance from apex of sacral hiatus were studied. **Results:** Various shapes of sacral hiatus were observed which included inverted U, inverted V, irregular, dumbbell, bifid and absent of sacral hiatus. **Conclusion:** The understanding of the sacral hiatus anatomy helps to define landmarks clinically used during the procedure of caudal anaesthesia.

Keywords: Caudal epidural anesthesia, Sacrum, Sacral hiatus.

Introduction:

Sacrum is a triangular bone forming the caudal end of the vertebral column, formed by fusion of five sacral vertebrae. Sacral hiatus is the opening present at the caudal end of sacral canal formed by the nonfusion of the lamina of the fifth (occasionally fourth) sacral vertebra. The fifth inferior articular processes project caudally and flank the sacral hiatus as the sacral cornua. The structures passing through sacral hiatus are a pair of 5th sacral nerves, a pair of coccygeal nerves, filum terminale externam, which passes to coccyx and fibro-fatty tissue. On the body



surface, the sacral hiatus lies about two inches above the coccyx and can be palpated as a concave depression between the sacral cornua above the sacrococcygeal joint.¹The sacral hiatus has been utilized for administration of caudal epidural anaesthesia in obstetrics as well as orthopaedic practice for treatment and diagnosis.² Anatomical landmarks and the knowledge of actual shape and size of sacral hiatus and its variations play a major role in the success of needle placement. Morphometric study of sacrum has been done by many workers in many different geographical areas across the globe. The most frequent problem encountered in caudal epidural block is needle placement as sometimes it is difficult to determine the anatomical location of sacral hiatus especially in

* Corresponding Author:

Dr. Ashish Khokhariya

E-mail: ashish331990@gmail.com

adults. Clinical evaluation of needle placement can be done with ultrasonography or fluoroscopy. However, it is not always feasible to do so because of time and cost constraints. Variations have been found in the shape and level of sacral hiatus. These studies have concluded that understanding the variations of sacral hiatus may improve the success of caudal epidural block.¹

The present study was undertaken to find out the anatomical variations of sacral hiatus in the Anatomy department at B.J Medical College, Ahmedabad.

Materials and Methods:

The present study was conducted in the Department of Anatomy, BJ Medical College, Ahmedabad, Gujarat 200 dry human sacra were collected from B.J 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. Antero-posterior diameter of sacral hiatus at the apex
6. Transverse width of sacral hiatus at the base – measured between the inner aspects of inferior limit of sacral cornua.

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

Inclusion criteria:-

- Normal sacrum with no abnormality

Exclusion criteria:-

- No sacral hiatus
- Dorsal wall agenesis
- Broken sacrum

Observations were substantiated with photographs.

Observations and Results:

Table 1 Shape of Sacral hiatus

Sr. No.	Shape	No	Percentage
1	Inverted U	98	50.51%
2	Inverted V	48	24.74%
3	Irregular	32	16.49%
4	Dumbbell	12	6.1%

In 3 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 six sacra were excluded from the measurements as typical sacral hiatus was

not present in them.

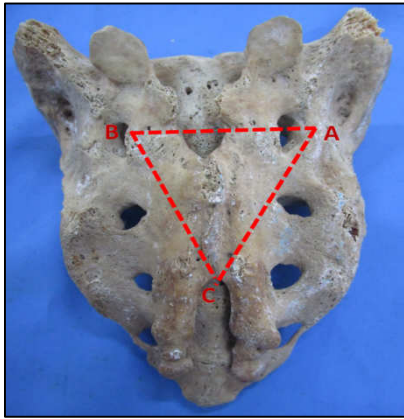
Image 1 Shape of Sacral Hiatus



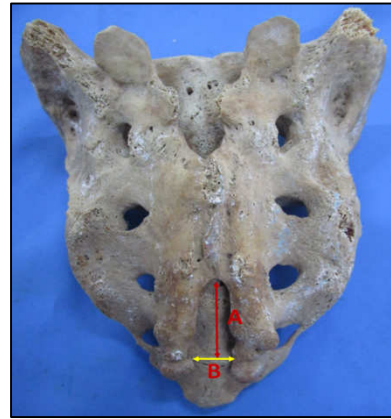
Table 2 Location of apex in relation to level of sacral vertebra

Sr. No.	Location of Apex	No	Percentage
1	4 th sacral vertebra	91	46.9%
2	3 rd sacral vertebra	83	42.7%
3	5 th sacral vertebra	11	5.6%
4	2 nd sacral vertebra	9	4.6%

Image 2 Construction of triangle ABC Image 3 Measurements of Sacral hiatus



A - Right superolateral sacral crest,
 B - Left superolateral sacral crest,
 C - Apex of sacral hiatus



A - Length of Sacral hiatus,
 B - Intercornual distance

Table 3 Location of base of hiatus in relation to sacral / coccygeal vertebra

Sr. No.	Location of Base	No	Percentage
1	5 th sacral vertebra	128	65.97%
2	4 th sacral vertebra	28	14.43%
3	Coccyx	38	19.5%

Table 4 Length of sacral hiatus from apex to midpoint of base

Sr. No.	Length	No	Percentage
1	0-10 mm	25	12.88%
2	11-20 mm	78	40.20%
3	21-30 mm	68	35.05%
4	31-40 mm	14	7.21%
5	41- 50 mm	6	3.09%
6	>51 mm	3	1.5%

Table 5 Antero-posterior diameter of Sacral canal at the level of apex

Sr. No.	Diameter	No	Percentage
1	0-3mm	4	2.06%
2	4-6mm	133	68.55%
3	7-9mm	56	28.86%
4	Above 9mm	1	0.51%

Table 6 Distance between the sacral cornua at base of sacral hiatus

Sr. No.	Distance	No	Percentage
1	0-5mm	12	6.1%
2	6-10mm	40	20.61%
3	10-15mm	128	65.97%
4	Above 16mm	14	7.21%

Discussion:-

In the present study, different parameters are studied on 200 human dry sacra.

1. Shape of sacral hiatus

Table 7 Comparison of different shape of sacral hiatus

Sr. No.	Study by Authors	Inverted 'U' (%)	Inverted 'V' (%)	Irregular (%)
1	Nagar et al ²	41.5	27	14.1
2	Seema et al ³	42.95	27.51	16.10
3	Nadeem et al ⁴	56	14	16
4	Osunwoke et al ⁵	24.1	33.3	13
5	Qudusia et al ⁶	62.37	22.16	8.76
6	Deepa S et al ⁷	57.5	25	17.5
7	Present study	50.52	24.74	16.49

As seen from, the findings of the present study coincide with the findings of, Nagar et al., Seema et al, Nadeem et al, Qudusia et al, Deepa S et al in all the aforementioned studies including the present study, inverted 'U' shaped sacral hiatus is the commonest.

The present study however does not coincide with Osunwoke et al. which states that inverted 'V' shaped sacral hiatus is the commonest.

2. Location of Apex of sacral hiatus in relation to sacral vertebra

Table 8 Comparison of apex of sacral hiatus at 4th sacral vertebra

Sr. No	Authors	Apex of sacral hiatus at 4 th sacral vertebra (%)
1	Vinod et al ⁸	76.23
2	Nagar et al ²	55.9
3	SekiguchiM et al ⁹	64
4	Present study	46

According to Vinod et al⁸,Nagar et al²,SekiguchiM et al⁹ and Present study the apex is located commonly at 4th sacral vertebra.

3. Location of base of sacral hiatus in relation to sacral vertebra

According to Vinod et al⁸,Nagar et al² and present study the base of sacral hiatus at 5th sacral vertebra are 83.17%, 72.6% and 65.97% respectively.

4. Length of sacral hiatus from apex to midpoint of base

By Vinod Kumar et al⁸ observed mean length of hiatus as 20 mm in males and 18.9 mm in females. Trotter et al¹⁰ 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 in which the length of hiatus varied from 0-60 mm with a mean of 22.5 mm and Lanier et al¹⁰ mean length of hiatus being 25.3±9 mm. Nagar et al² and in present study mean length between 11-20mm in 92 vertebra & 78 vertebra respectively.

5. Antero-posterior diameter of sacral canal at the level of apex

Most common mean diameter according to Nagar et al² and in present study are 4-6mm in 169 & 133 vertebra respectively.

6. Distance between the sacral cornua at base of sacral hiatus

According to Nagar et al², Shinde et al¹ & present study intercornual distance ranging between 11 mm and 15 mm are 54%, 59.6% & 65.97%.

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.

References:-

1. Shinde AA, Manvikar PR, Bharambe VK. Morphometric study of sacral hiatus and its significance in caudal epidural anesthesia. *Sahel Med J.* 2015;18(3):134-138. doi:10.4103/1118-8561.169281.
2. Nagar SK. A Study of Sacral Hiatus in Dry Human Sacra. *J Anat Soc India.* 2004;53(2):18-21.
3. Seema, Singh M MA. An Anatomical Study of Variations of Sacral Hiatus in Sacra of North Indian Origin and Its Clinical Significance. *Int J Morphol.* 2013;31(1):110-114.
4. Nadeem G. Knowing the level of sacral hiatus for caudal epidural anesthesia. *J Morphol Sci.* 2014;31(1):9-13.
5. Osunwoke E, Oladipo G, Allison TA OEA. Study of Sacral Hiatus in Dry Human Sacra in Southern Nigeria. *J Biol Agric Healthc.* 2014;4(5):43-48.
6. Qudusia S, Shariff MH, Jacob M, Rao CP AR. A Morphological study of sacral hiatus with its clinical implications. *Indian J Appl Res.* 2014;4(2):34-37.
7. Deepa S, Ss R. Original article Anatomical study of the sacral hiatus. *Int J Healthc Biomed Res.* 2014;3(1):31-35.
8. Vinod Kumar, Pandey SN, Bajpai RN, Jain PN LG. Morphometrical study of sacral hiatus. *J Anat Soc India.* 1992;41(1):7-13.
9. Al S et. An anatomic study of the sacral hiatus: A basis for successful caudal epidural block. *clin J Pain.* 2004;20:51-54.
10. Trotter M LG. Variations of the female sacrum; Their significance in continuous caudal analgesia. *Surg Gynaecol Obs.* 1944;78(4):419 – 424.