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# A Morphometric and Morphlogical Study of Sacral Hiatus and its Clinical Significance in Caudal Epidural Anesthesia

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**Abstract:** ***Background: Sacrum is a triangular wedge-shaped bone which is formed by fusion of five sacral vertebrae. It is present between the two in nominate bones forming postero – superior wall of pelvic cavity. Anatomy of the sacral hiatus is having clinical importance during caudal epidural block. In adults it is sometimes difficult to determine the anatomical location of the sacral hiatus and the caudal epidural space. Caudal epidural block (CEB) is widely used to provide anesthesia for various clinical procedures; treatment of lumbar spinal disorders and for the management of chronic back pain. Objective: To determine the shapes of sacral hiatus, Antero-posterior diameter & transverse width of sacral hiatus at the apex, and Distance between the sacral crest. Material and Methods: The study was conducted on 100 dried sacrum of unknown sex in Rajasthan population from the collection of Department of anatomy of Mahatma Gandhi Medical College & Hospital Jaipur. Results: Various shapes of sacral hiatus were observed which included Inverted-V (26%), Inverted- U (39%), Dumbell (11%), Elongated (2%), Bifid (17%), Irregular (5%). The mean anteroposterior diameter of sacral canal at the apex of sacral hiatus was 5.81mm. The mean transverse width of sacral hiatus at apex was 10.29mm. The mean value of distance between the two supero lateral crests and the distance between the apex of sacral hiatus and the right and left supero lateral sacral crests were 63.02, 62.18 and 47.95 mm respectively. Conclusion: The sacral hiatus has anatomical variations and these variations may improve the reliability of caudal epidural anaesthesia. There are anatomical variations in the shape and level of the sacral hiatus which may lead to failure of caudal anaesthesia.***

## 1. Introduction

Sacrum is a triangular wedge-shaped bone which is formed by the fusion of five sacral vertebrae. It is present between the two innominate bones forming postero-superior wall of pelvic cavity[8]. Egyptians considered this bone sacred to "Osiris" the god of resurrection and of agriculture[3]. Sacrum support erect spine and provide strength and stability to the bony pelvis for transmission of body weight[7].

The opening at caudal end of sacral canal is known as sacral hiatus, which is formed due to failure of fusion of laminae of fifth sacral vertebrae (occasionally fourth) making it arc shaped gap[3]. The sacral hiatus is bordered laterally by two sacral cornua and could be palpable as a dimple in between. The sacral hiatus contains lower sacral and coccygeal nerve root, filum terminale externa and fibrofatty tissue[3]. The inverted U or V shape and extent of sacral hiatus covered by sacrococcygeal membrane is proved important landmark to perform caudal epidural block (CEB) anesthesia through sacral hiatus[9]. The sacral hiatus is identified by the palpation of sacral cornua, felt at the upper end of the natal cleft 5cm above the tip of the coccyx[3]. 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[3]. Single bony landmark may not help in locating sacral hiatus because of anatomical variations[21].

## 2. Materials and Method

The study was performed at Department of Anatomy Mahatma Gandhi Medical College, Jaipur (Rajasthan). A total number of 100 dried sacrum bones of unknown age and gender will be included in the study.

Only fully ossified, dried and thoroughly cleaned sacra which are complete in all respects, in order to get correct and comprehensive observations, was included in the study. Damaged sacrum will be excluded from the study. All the parameters were measured by using sliding Vernier caliper. The observation will be made on following parameters.

### 2.1 Parameters

**A) Nonmetric parameters**

- Different shapes of the sacral hiatus and their percentage distribution of each.

**B) Metric parameters**

- Transverse width of sacral hiatus at the base.
- Anteroposterior diameter of sacral hiatus at the apex.
- Distance between the sacral crest- superolateral sacral crest, right and left superolateral crest and sacral hiatus apex.

## 3. Result

The morphological and morphometric observations of the sacral hiatus in dried human sacrum belonging to Rajasthan population are as follows:

**Table 1:** The no. and percentage of various shapes of sacral hiatus (N= total number of sacrum) different Shapes of Sacral Hiatus

| Shapes of sacral hiatus | No. of Specimens (n=100) | Percentage (%) |
|---|---|---|
| Inverted U-shaped | 39 | 39 |
| Inverted V-shaped | 26 | 26 |
| Dumbell shaped | 11 | 11 |
| Elongated shaped | 2 | 2 |
| Bifid shaped | 17 | 17 |
| Irregular shaped | 5 | 5 |

- We studied 100 sacral hiatus to observe basically six shapes of sacral hiatus as Inverted U-shaped, Inverted V-shaped, Dumbell shaped, elongated shaped, Bifid shaped and Irregular shaped. The distribution of different shaped of sacral hiatus have been showed in ( Table : 1).
- In present study we found the most common shape was inverted-U shape (39 %) and the least common shape was Elongated (2%).


**Figure 1:** A. Inverted U-shaped; B. Inverted V-shaped; C. Elongated shape; D. Dumbell shaped; E. Bifid shaped; F. Irregular shaped

### 3.1 Morphometric Analysis of Sacrum

**Table 2:** Morphometric analysis of sacrum. (A-P= Anteroposterior diameter)

| S.no | Parameter | Range (Min.-Max.) | Mean Value (MM) | SD |
|---|---|---|---|---|
| 1. | Transverse width of sacral hiatus at apex | 4.25 – 17.67 | 10.29 | 2.74 |
| 2. | A-P diameter of sacral hiatus at the apex | 1.29 – 11.59 | 5.81 | 2.32 |

The mean transverse width of sacral hiatus at apex was 10.29 mm. The anteroposterior diameter of sacral hiatus at the apex was 5.81 mm observed in present study.

**Figure 2:** Transverse width of sacral hiatus at the base


**Figure 3:** Anteroposterior (AP) diameter of sacral hiatus at the apex

**1) Measurements of distances between the superolateral sacral crests and their distances from the apex of sacral hiatus**

**Table 3:** Measurements of distances between the superolateral sacral crests and their distances from the apex of sacral hiatus

| S.no | Parameter | Range (Min.-Max.) | Mean value (mm) | SD |
|---|---|---|---|---|
| 1. | Distance between two superolateral crest (base of triangle) [B-A] | 32.73 – 63.64 | 47.95 | 6.71 |
| 2. | Distance between right superolateral crest and sacral hiatus apex [A-C] | 32.19 – 91.38 | 63.02 | 11.62 |
| 3. | Distance between left superolateral crest and sacral hiatus apex [B-C] | 33.24 – 91.65 | 62.18 | 11.49 |

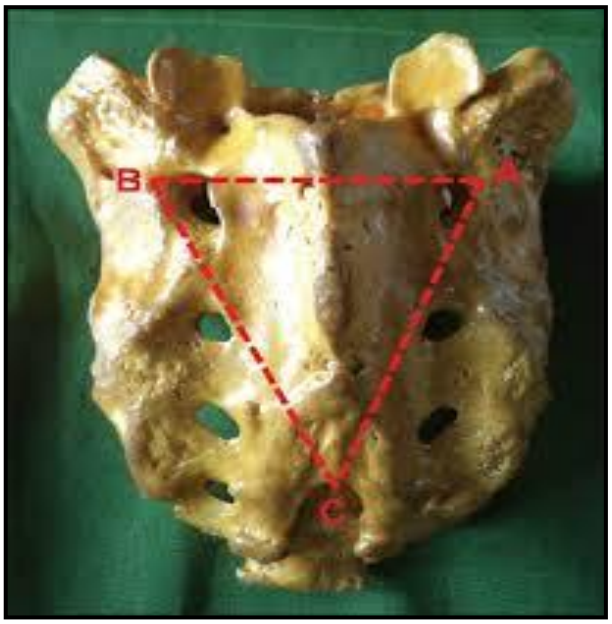


**Figure 4:** a) Distance between two superolateral sacral crest (base of the triangle) [B-A] b) Distance between right superolateral crest and sacral hiatus apex [A-C] c) Distance between left superolateral crest and sacral hiatus apex [B-C]

- The Range (32.73 – 63.64), mean value (47.95) and SD (6.71) of distance between two superolateral crest (base of triangle) were observed in present study.
- The Range (32.19 – 91.38), mean value (63.02) and SD (11.62) of distance between right superolateral crest and sacral hiatus apex were observed in present study.
- The range (33.24 – 91.65), mean (62.18) and SD (11.49) of distance between left superolateral crest and sacral hiatus apex were observed in present study.

## 4. Discussion

### 4.1 Shapes of sacral hiatus

Variation in shapes of sacral hiatus is observed in present study. Most commonly Inverted-U shaped sacral hiatus (39%) followed by Inverted -V shaped (26%), dumbbell shaped (11%), elongated shaped (2%), bifid shaped (17%) and irregular shaped (5%).

Nagar S.K et al also noted various shapes of sacral hiatus , most commonly Inverted -U (41.50%) followed by Inverted -V (27%), dumbbell (13.30%) ,bifid (1.50%) and irregular (14.10%). Anjali Aggrawal et al also noted various shapes Inverted -U (40.3%), Inverted V (31.57%) , bifid (4.30%) and the least was found to be of irregular (15.57%).

Inverted U- shaped sacral hiatus was observed (38%) in present study which is similar to Kamal AHMM et al (39%).

The Inverted U- shape found (39%) which is highest. When present study compared with other author it found insignificant.

| Author | Year | Population | N | Sex | Shapes of Sacaral Hiatus | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Inverted U | P-value | Inverted V | P-value | Dumbbell | P-value |
| Nagar SK | 2004 | Gujarat | 270 | | 41.50% | **0.33119** | 27.00% | **0.423045** | 13.30% | **0.269816** |
| Anjali Aggarwal | 2009 | Chandigarh | 114 | | 40.30% | **0.42308** | 31.57% | **0.183709** | | 0.000219 |
| Njihia B N | 2011 | Kenya | 88 | | 16.70% | 0.00020 | 32.00% | **0.182767** | * 31.00% | 0.000307 |
| Dipali Rani Pal | 2012 | Banagladesh | 160 | | 40.00% | **0.43622** | 27.60% | **0.388187** | 12.50% | **0.356484** |
| Clarista M Q | 2013 | Kerela | 104 | | 46.20% | **0.14857** | 24.00% | **0.370781** | 6.70% | **0.139680** |
| Ramamurthi K S | 2013 | Tamilnadu | 116 | | 31.00% | **0.10915** | 25.80% | **0.486657** | 5.00% | **0.053677** |
| Seema | 2013 | Amritsar | 149 | | 42.95% | **0.26673** | 27.51% | **0.395748** | 13.41% | **0.282735** |
| Mrudula C | 2013 | Hyderabaad | 100 | | Most common sound | | | | | |
| Manisha B Sinha | 2014 | Chattisgarh | 68 | | 35.93% | **0.34298** | 17.18% | **0.082005** | 7.81% | **0.239891** |
| Kamal AHMM | 2014 | Dhaka | 172 | | 38.00% | **0.43513** | 35.10% | **0.055173** | 5.30% | **0.054916** |
| Ashraf Y Nasr | 2014 | Saudi Arabia | 150 | | 31.33% | **0.10711** | 38.66% | 0.016241 | 12.00% | **0.403709** |
| UkohaUkoha U | 2014 | Nigiria | 83 | | 48.20% | **0.10502** | 34.90% | **0.096190** | 4.80% | **0.056450** |
| Mishra M | 2014 | Andhra Pradesh | 93 | | 50.53% | **0.05264** | 26.90% | **0.443688** | 5.40% | **0.076005** |
| Malarvani T | 2015 | Nepal | 100 | | 35.00% | **0.27882** | 32.00% | **0.174368** | 3.00% | 0.012389 |
| Rajapur Parashuram | 2015 | Karnatka | 200 | | 50.00% | 0.03393 | 27.50% | **0.390680** | 2.00% | 0.003049 |
| Renu Chauhan | 2015 | Delhi | 46 | Male | 13.00% | 0.00009 | 13.00% | 0.024783 | | |
| | | | 14 | Female | • 5.00% | 0.00000 | • 3.00% | 0.000139 | | |
| M D Jawed Akhtar | 2016 | Bihar | 124 | | 44.36% | **0.20872** | 35.48% | **0.061301** | 4.84% | 0.046842 |
| A. Bharathi | 2016 | Telangana | 60 | | 40.00% | **0.45018** | 45.00% | 0.007284 | • 1.70% | 0.004364 |
| Mritunjay Pandey | 2016 | UP | 100 | Male | 48.00% | **0.09870** | 32.00% | **0.174368** | 2.00% | 0.004325 |
| | | | | Female | 64.00% | 0.00013 | 26.00% | **0.500000** | 4.00% | 0.028977 |
| Vandana K Punase | 2016 | MP | 66 | | 33.33% | **0.22723** | 33.33% | **0.156793** | | |
| Dona Saha | 2016 | Kolkata | 117 | | * 70.09% | 0.00000 | 14.53% | 0.017898 | 0.85% | 0.000872 |
| Pooja Singh | 2016 | UP | 67 | | 22.39% | 0.00925 | 22.39% | **0.295599** | 17.91% | **0.109979** |
| Sunil J Pundge | 2017 | Maharashtra | 103 | | 38.50% | **0.47086** | 34.00% | **0.105835** | 5.00% | **0.056934** |
| Rajani Singh | 2017 | Uttarakhand | | | 42.95% | | 27.51% | | | |
| Harvinder Singh | 2017 | Gurugram | 31 | | 41.93% | **0.38605** | 29.03% | **0.371719** | 12.90% | **0.389726** |
| William FM | 2017 | Rajasthan | 75 | | 30.66% | **0.12404** | 42.00% | 0.013047 | 10.66% | **0.471421** |
| Present Study | 2019 | Rajasthan | 100 | | 39.00% | | 26.00% | | 11.00% | |

| Author | Year | Population | N | Sex | Shapes of Sacaral Hiatus | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Elongated | P-value | Bifid | P-value | Irregular | P-value |
| Nagar SK | 2004 | Gujarat | 270 | | | | 1.50% | 0.000026 | 14.10% | 0.001375 |
| Anjali Aggarwal | 2009 | Chandigarh | 114 | | | | 4.30% | 0.001276 | 15.70% | 0.004079 |
| Njihia B N | 2011 | Kenya | 88 | | | | | 0.000003 | 19.00% | 0.001495 |
| Dipali Rani Pal | 2012 | Banagladesh | 160 | | | | | 0.000003 | 20.00% | 0.000047 |
| Clarista M Q | 2013 | Kerela | 104 | | | | 2.90% | 0.000293 | 9.60% | **0.101830** |
| Ramamurthi K S | 2013 | Tamilnadu | 116 | | * 17.20% | 0.000028 | | | 20.60% | 0.000163 |
| Seema | 2013 | Amritsar | 149 | | | | | | * 24.00% | 0.000002 |
| Mrudula C | 2013 | Hyderabaad | 100 | | | | | | | |
| Manisha B Sinha | 2014 | Chattisgarh | 68 | | | | 7.81% | 0.032215 | 15.62% | 0.015315 |
| Kamal AHMM | 2014 | Dhaka | 172 | | 5.80% | 0.046803 | 0.60% | 0.000008 | 15.20% | 0.001778 |
| Ashraf Y Nasr | 2014 | Saudi Arabia | 150 | | | | 2.66% | 0.000157 | 15.33% | 0.002389 |
| UkohaUkoha U | 2014 | Nigiria | 83 | | | | 4.80% | 0.002938 | 4.80% | **0.475101** |
| Mishra M | 2014 | Andhra Pradesh | 93 | | | | | | 11.80% | 0.044270 |
| Malarvani T | 2015 | Nepal | 100 | | | | 2.00% | 0.000091 | 14.00% | 0.014031 |
| Rajapur Parashuram | 2015 | Karnatka | 200 | | | | 2.00% | 0.000056 | 15.50% | 0.000893 |
| Renu Chauhan | 2015 | Delhi | 46 | Male | | | 1.00% | 0.000036 | 19.00% | 0.011758 |
| | | | 14 | Female | | | 1.00% | 0.000254 | 5.00% | **0.500000** |
| M D Jawed Akhtar | 2016 | Bihar | 124 | | | | 4.03% | 0.000891 | 8.87% | **0.124486** |
| A. Bharathi | 2016 | Telangana | 60 | | | | 1.70% | 0.000099 | • 1.70% | **0.114648** |
| Mritunjay Pandey | 2016 | UP | 100 | Male | | | 8.00% | 0.026048 | 10.00% | **0.088765** |
| | | | | Female | | | • 0.00% | 0.000003 | 6.00% | **0.378191** |
| Vandana K Punase | 2016 | MP | 66 | | 6.06% | **0.106038** | 3.03% | 0.000592 | 24.24% | 0.000374 |
| Dona Saha | 2016 | Kolkata | 117 | | | | 1.71% | 0.000053 | 12.82% | 0.019331 |
| Pooja Singh | 2016 | UP | 67 | | | | 8.96% | **0.058417** | 19.40% | 0.003293 |
| Sunil J Pundge | 2017 | Maharashtra | 103 | | | | 3.00% | 0.000334 | 10.00% | **0.086687** |
| Harvinder Singh | 2017 | Gurugram | 31 | | 3.22% | **0.362420** | 3.22% | 0.002529 | 9.67% | **0.207868** |
| William FM | 2017 | Rajasthan | 75 | | | | *10.66% | **0.110384** | 13.66% | 0.027821 |
| Present Study | 2019 | Rajasthan | 100 | | 2.00% | | 17.00% | | 5.00% | |

• Indicates the lowest value and * indicates the highest value
Bold p – value shows that are not significant
Unbold p – value shows significant difference

**Anteropoaterior Diameter of Sacral Hiatus at the Level of APEX**

In present study the anteroposterior diameter range from 1.29mm to 11.6mm with the mean range from 5.81 ± 2.32 mm which is significantly differed from other researchers except Clarista MQ et al, Dona Saha et al, UkohaUkoha et al, M D Jawed Akhtar et al.

**Transverse Width at the Level of Base of Sacral Hiatus**

The transverse width of sacral hiatus in our study ranged between 4.25 to 17.67 mm , the arithematic mean width range with SD between 10.29 ± 2.74 which is lowest in contrast to other authors and differed significantly.

| Authors | Year | Population | N | Sex | AP Diameter (mm) | | P - Value | Transverse Width (MM) | | P - Value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mean ± SD | Range | | Mean ± SD | Range | |
| Nagar S K | 2004 | Gujarat | 270 | | 4.88 | 2 – 14 | 0.00003 | – | – | |
| Anjali Aggarwal | 2009 | Chandigarh | 114 | | 5.03 ± 1.57 | 1.9 - 10.40 | 0.00226 | 11.99 ± 2.78 | 6 - 23.3 | 0.00002 |
| Njihia B N | 2011 | Kenya | 88 | | 6.4 | – | | 12.6 | – | |
| Dipali Rani Pal | 2012 | Bangladesh | 160 | | 5.34 ± 1.39 | 4 – 6 | 0.03356 | 12.75 ± 2.92 | – | 0.00000 |
| Clarista M Q | 2013 | Bangladesh | 104 | | 5.58 ± 1.66 | 1.98 - 9.92 | 0.20852 | 16.87 ± 3.66 | 6.48 - 29.20 | 0.00000 |
| Ramamurthi K S | 2013 | Tamil nadu | 116 | | – | – | | 16.2 ± 27 | 10 – 22 | 0.02560 |
| Seema | 2013 | Amritsar | 149 | | 4.7 | 2 – 14 | | – | 11 – 25 | |
| Manisha B Sinha | 2014 | Chattisgarh | 68 | | 3.1 ± 6 | – | 0.00019 | – | | |
| Kamal AHMM | 2014 | Dhaka | 172 | Male | 4.76 ± 1.73 | 1.50 - 8.57 | 0.00004 | 17.29 ± 3.89 | 7.11 - 25.01 | 0.00000 |
| | | | | Female | 4.92 ± 2.13 | 0.18 - 13.4 | 0.000001 | * 18.01±3.70 | 2 to 24.49 | 0.0000001 |
| Ashraf Y Nasr | 2014 | Saudi Arabia | 150 | | 4.78 ± 1.87 | 1 – 9 | 0.00010 | 11.5 ± 3.1 | 4 – 17 | 0.00207 |
| UkohaUkoha U | 2014 | Nigeria | 83 | | 5.52 ± 1.89 | 0.4 - 11.10 | 0.17572 | 12.35 ± 3.12 | 5.0 - 20.50 | 0.00001 |
| Mishra M | 2014 | Andhra Pradesh | 93 | | 4 | 2 – 9 | 0.00000 | 12.11 | 4 – 18 | |
| Amol A Shinde | 2015 | Maharashtra | 300 | | – | 1.9 - 9.2 | | – | 8.5 - 25.7 | |
| Malarvani T | 2015 | Nepal | 100 | | – | 2 – 9 | | – | 7 – 27 | |
| RajapurParashuram | 2015 | Karnataka | 200 | | – | 1.5 - 8.5 | | – | 1 – 19 | |
| M D Jawed Akhtar | 2016 | Bihar | 124 | | 5.39 ± 1.96 | 2.1 - 10.87 | 0.07462 | 12.14 ± 3.89 | 4.25 - 19.58 | 0.00007 |
| A Bharathi | 2016 | Hyderabad | 60 | | * 7.25 | 5 – 14 | | – | – | |
| Mritunjay Pandey | 2016 | UP | 100 | | – | 3 – 6 | | – | 5 -- 14 | |
| Dona Shah | 2016 | Kolkata | 117 | | 6.02 ± 2.43 | 2 - 12.50 | 0.25776 | 12.10 ± 3.13 | 6 -- 21.10 | 0.00001 |
| Pooja Singh | 2016 | UP | 67 | | – | 1.5 - 12.5 | | – | 3 -- 18 | |
| Harvinder Singh | 2017 | Gurugram | 31 | | 4.61 | – | | 12.32 | | |
| William FM | 2017 | Rajasthan | 75 | | 0.5 ± 0.118 | 0.3 - 0.8 | 0.00000 | 15 ± 2.449 | 10 -- 20 | 0.00000 |
| BabitaKujur | 2017 | Odisha | 44 | male | 4.18 ± 1.46 | – | 0.00000 | 15.74 ± 1.35 | – | 0.00000 |
| Present Study | 2019 | Rajasthan | 100 | | 5.81 ± 2.32 | 1.29 - 11.6 | | 10.29 ± 2.74 | 4.25 - 17.67 | |

• Indicates the lowest value and * indicates the highest value
Bold p – value shows that are not significant
Unbold p – value shows significant difference

**Distance between the superiolateral sacral crests and their distances from the apex of sacral hiatus**

In the present study the mean value of distance between two superolateral crests (base of triangle) was lowest 47.95mm ranged from 32.73 to 63.64mm. Right superolateral and left superolateral crests were observed 63.02 mm and 62.18 mm respectively , whereas the study done by K Thirumagal et al (2018) succeeded over the present study as observed value was 67.5mm, 65mm and 65mm respectively . Right superolateral crest is significantly differed from N Senoglu et al (67.1 ± 10) and Anjali Aggarwal et al (59.92 ± 8.4), who used posterior superior iliac spine for base of equilateral triangle instead of superolateral crest.

Left superolateral crest also differed significantly from N Senoglu et al (67.5 ± 9.5).

| Authors | Year | Population | N | Distance Between Two superolateral Sacral crest {B-A} | | | Distance Between Right superolateral crest and sacral hiatus apex {A-C} | | | Distance Between Left superolateral crest and sacral hiatus apex {B-C} | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Mean ± SD | Range | P-value | Mean ± SD | Range | P-value | Mean ± SD | Range | P-value |
| N Senoglu | 2005 | Turkey | 96 | *66.5 ± 53.5 | 51 - 79.5 | 0.0004 | * 67.1 ± 10 | 42.1 - 89 | 0.0042 | * 67.5 ± 9.5 | 46 -88 | 0.00020 |
| Anjali Aggarwal | 2009 | Chandigarh | 114 | • 50.96 ± 6.69 | 20 - 75 | 0.0005 | • 59.92 ± 8.4 | 36 - 78 | 0.0136 | • 59.99 ± 8.31 | 37 - 76 | 0.05728 |
| Patil Dhananjay | 2012 | Gujarat | 103 | 60..5 ± 6.7 | 43 - 78 | 0.00000 | 61.95 ± 11.7 | 29 - 95 | 0.2567 | 61.4 ± 11.98 | 28 - 91 | 0.31793 |
| Clarista M Q | 2013 | Kerela | 104 | 64.96 ± 5.44 | 49.10 - 79.40 | 0.00000 | 62.64 ± 9.62 | 34.1- 83.9 | 0.3998 | 62.33 ± 9.92 | 34.5-83.9 | 0.46032 |
| Vandana K Punase | 2016 | MP | 66 | 64.83 ± 6.87 | 48.60 - 85.10 | 0.00000 | 63.16 ± 9.07 | 39 - 85.30 | 0.4654 | 62.53 ± 9.03 | 44 - 83.40 | 0.41335 |
| Dona Saha | 2016 | KolKata | 117 | 62.38 ± 6.19 | 46.60 - 89.10 | 0.00000 | 63.38 ± 9.21 | 37.5 - 84.1 | 0.4013 | 63.50 ±9.20 | 37.5- 84.1 | 0.17791 |
| Babita Kujur | 2017 | Odisha | 44 | 62.60 ± 5.58 | – | 0.00000 | 64.02 ± 9.19 | – | 0.2901 | 64.37 ± 9.77 | – | 0.12053 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Present Study | 2019 | Rajasthan | 100 | 47.95 ± 6.71 | 32.73 - 63.64 | | 63.02 ± 11.62 | 32.2-91.4 | | ± 11.49 | 33.27-91.65 | |

• Indicates the lowest value and * indicates the highest value
Bold p – value shows that are not significant
Unbold p – value shows significant difference

## 5. Summery and Conclusion

The present study has been carried out to determine the average mean and standard deviation of various parameters of sacral hiatus. There are anatomical variations in the shape and the level of the sacral hiatus which may lead to failure of caudal anaesthesia. When the anaesthetist notices an abnormality of sacral hiatus, he/she should choose lumbar epidural anaesthesia or other procedures to avoid the risk of soft tissue injury. The sacral hiatus has anatomical variations and these variations may improve the reliability of caudal epiduralanaesthesia.

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