

Original Article

RELATION OF LOW BACK PAIN WITH LEVEL OF SACRAL HIATUS IN WEST BENGAL POPULATION – AN OSTEO-RADIOLOGICAL STUDY

¹Dr. Ram Chandra Bhadra , ²Dr. Dona Saha

¹ Associate Professor, Department of Radiodiagnosis, Nilratan Sircar Medical College, Kolkata – 700014, West Bengal, India.

²Demonstrator, Department of Anatomy , Nilratan Sircar Medical College, Kolkata – 700014, West Bengal, India.

Corresponding author: Dr. Dona Saha

ABSTRACT

Objective: This osteological and radiographic study was designed to identify the variations of sacral hiatus in dry sacral bone and association of the variations of sacral hiatus of the patients presented with low back pain. Sacral hiatus is used as a route for caudal epidural block for anaesthesia and analgesia.

Methods: Three hundred and thirty-eight (173 male and 165 female) undamaged adult dry human sacrum and one hundred and sixty-seven (70 male and 97 female) radiographs of patient with low back pain were included in the present study.

Result: In dry sacrum, commonly observed shape was inverted U (63.58% in male and 67.28% in female sacra). Apex of sacral hiatus was mostly located at S4 level, 73.41% in male and 72.73% in female sacra in dry bone. In radiograph of patient with low back pain, apex of sacral hiatus was observed mainly in S3 level in 47.14% and 46.39% in male and female respectively. Deficient dorsal wall of sacrum was found in 1.16% in male and 3.03% in female in dry bone and 7.14% in male patient and 11.34% in female patient with low back pain.

Conclusion: The patient with low back pain had a higher percentage of dorsal wall defect and higher incidence of sacral hiatus apex locating at S2 and S3 level.

Key words: sacrum, sacral hiatus, deficient dorsal wall, low back pain, radiograph.

INTRODUCTION

The sacrum is a large, triangular bone formed by the fusion of five vertebrae and it forms the postero-superior wall of the pelvic cavity, wedged between the two innominate bones.¹ Sacral Hiatus(SH) is formed due to failure of fusion of laminae of fifth (occasionally fourth) sacral vertebra. It is located inferior to the fourth (or third) fused sacral spine at the lower end of median sacral crest.¹

Sacral approach to epidural space produces reliable and effective way to block the sacral nerves. The sacral hiatus functions as a landmark for anaesthesia in urology, proctology, general surgery, orthopedic, obstetrics and gynecology practice for treatment and diagnosis.² It is also used for three-

dimensional color visualization of lumbosacral epidural space.³ The distal-most portion of the dural sac terminates at the level of S2-this is the importance of determining the anatomic location of the sacral hiatus during caudal epidural block(CEB). So anatomical variation of sacral hiatus may relate to the failure of CEB, transpedicular and lateral mass screw placement.⁴

Anatomical variations occur frequently in this region making the sacrum the most variable portion of the spine.⁵ Developmental malformations can occur ranging from variations in sacral hiatus to caudal agenesis.⁶ This lead to decrease surface area for the attachment of extensor muscles at the back which may lead to painful conditions of the back.⁷

In the present study, we investigated the incidences

of shape of hiatus and position of sacral hiatus apex in dry bone and association of variations of sacral hiatus with the patients presented with low back pain (LBP).

METHODOLOGY

Three hundred and thirty-eight (173 male and 165 female) complete and undamaged adult dry sacrum of known sex were collected from the students and Anatomy department of Nilratan Sirkar Medical College, Kolkata, West Bengal. Each sacrum was studied for the shape of sacral hiatus and the level of apex of sacral hiatus in relation to the sacral vertebral segment. One hundred and sixty seven (70 male and 97 female) AP lumbosacral radiographs of patients with history of LBP were obtained from the department of radio-diagnosis of Nilratan Sirkar Medical College and Hospital,

Kolkata. The level of sacral hiatus was noted in the radiographs and the data was compared according to the gender. The data was tabulated and analysed.

RESULTS

Shape of sacral hiatus :

Among the different shapes inverted U, inverted V, irregular and bifid with a nodular bony growth projecting medially from both margins were observed in male and female human sacra (fig:1). Inverted U was seen in 63.58% of male and 67.28% of female dry sacra , followed by inverted V . Incidences were tabulated on table 1. Deficient dorsal wall of dry sacrum were found in 1.16% and 3.03% in male and female respectively (Table :1) and 7.14% of male and 11.34 % of female in radiogram of lumbosacral spine.(Table :3)

Table 1: Incidence of shape of sacral hiatus in dry human sacrum (Total 338 sacra)

Shape of hiatus	Male (173)	Female (165)
Inverted U	110 (63.58%)	111 (67.28%)
Inverted V	38 (21.96%)	35 (21.21%)
Irregular	21 (12.14%)	13 (7.88%)
Bifid	2 (1.16%)	1 (0.60)
Deficient dorsal wall	2 (1.16%)	5 (3.03%)

Apex of sacral hiatus :

Apex of sacral hiatus ranged from 2nd to 5th sacral vertebra in dry human sacrum and also in radiograph of patients having LBP (Fig:3). Incidences were depicted in table 2 and table 3. In majority of cases apex was located at 4th sacral

vertebra in both sex in dry sacrum and at 3th sacral vertebra in both sex in patient with LBP. Deficient dorsal wall was observed in 7.14% of male and 11.34% of female patient with LBP. Incidence of absent sacral hiatus was less in both dry bone and in X-ray.

Table 2: Incidence of level of apex of sacral hiatus in dry human sacrum

(Total 338 sacra)

Level of apex of hiatus	Male (173)	Female (165)
Deficient dorsal wall	2 (1.16%)	5 (3.03%)
2 nd Sacral vertebra	4 (2.31%)	3 (1.82%)
3 rd Sacral vertebra	34 (19.65%)	32 (19.39%)
4 th Sacral vertebra	127 (73.41%)	120 (72.73%)
5 th Sacral vertebra/Absent	6 (3.47%)	5 (3.03%)

Table 3: Incidence of level of apex of sacral hiatus in radiogram with history of low back pain; (Total 167 radiogram)

Level of apex of hiatus	Male (70)	Female (97)
Deficient dorsal wall	5 (7.14%)	11 (11.34%)
2 nd Sacral vertebra	9 (12.86%)	14 (14.43%)
3 rd Sacral vertebra	33 (47.14%)	45 (46.39%)
4 th Sacral vertebra	21 (30.00%)	26 (26.81%)
5 th Sacral vertebra/absent	2 (2.86%)	1 (1.03%)

DISCUSSION

Sacral approach to the epidural space produce reliable and effective block of sacral nerves for various diagnostic and therapeutic procedure⁸ Jean-Anthanase Sicard, a radiologist, was the first to describe injection of dilute solutions of cocaine through the sacral hiatus into the epidural space in 1901, to treat patients suffering from severe, intractable sciatic pain or lumbago.⁹ Edward and Hingson in 1941, for the first time took the advantage of this natural gap at the lower end of sacral canal for continuous caudal analgesia during labour.¹⁰ A failure rate of 25% has been reported by some investigator.¹¹

In present study, most commonly observed shape of SH in dry bone was inverted U (65.38%) which also correspond with the study of Bhattacharya S¹² (65%) in identical population, and with the study of Sultana Q¹³ (62.37%) among South Indian population. Other shapes found in this study were inverted V (21.60%), irregular (10.06%), bifid (0.88%) and complete dorsal wall defect (2.07%).

Aggarwal *et al.*⁸(2009) stated that inverted U and V shapes were the most common types (70.79%). Irregular shaped hiatus was found in 10.06% cases which closely correspond with Suma HY¹⁴ (10.1%), Shewale¹⁵ (9.31%) and Bhattacharya S¹² (12%). The most favourable shapes for caudal epidural block are inverted U and inverted V as they provide adequate space for introducing needle into epidural space without any obstacle. The other listed shapes due to its irregularity may obstruct needle insertion and even lead to needle breakage.⁸ (Table 4)

According to Senoglu *et al.*¹⁶ complete agenesis of dorsal wall in dry sacrum may be a cause of CEB failure which they reported in 6.25% cases. Similar findings were recorded by Sekiguchi¹⁷ in 1% cases, Nagar SK¹⁸ in 1.5% cases and letterman and Trotter² in 0.7% in male cases and 0.3% in female cases, Kumar V¹⁹ in 2.7% in male cases and 12.5% in female case and in our study 1.16% in male cases and 3.03% in female case. (Table 4) When the above data was compared to the radiograph of

the patient with LBP, it was found that dorsal wall was deficient in 7.14 % of male and 11.34% of female in our study and in 40 % of male and 27.2 % of female in study of Kumar V.¹⁹(Table 5&6) These kind of anomaly can lead to low back ache, due to the pressure of spinous processes of the fifth lumbar vertebra in the nerve roots through the membrane closing spina bifida.²⁰ Lack or hypoplasia of posterior elements in spina bifida occulta can also lead to low back pain.²¹

Variations of SH can ranges from total posterior closure defect up to the absent SH. Stranding et al¹ states that the apex of sacral hiatus is present at 4th sacral vertebrae. In the present study, the most common location of SH was at the level of the 4th sacral vertebrae in male (73.41 %), and female (72.73%) dry sacra. These results were close to those reported by Kumar V¹⁹ (male- 81.4% , female- 61.2%) but differ from Mustafa M²² (male- 54.54% and female- 83.34%) .Irrespective of sex, apex at S3 level was seen on 19.53% cases which almost similar to study of Sultana Q¹³ (18.94%) but higher than Aggarwal A⁸, Kumar V¹⁹, Shewale SN¹⁵. Frequency of the hiatal apex at S2 level corresponds with the study of Sultana Q¹³, Aggarwal A⁸, Kumar V¹⁹.(Table 4) The level of S3 was the most common location of SH apex in AP lumbosacral spine radiographs in males and females (47.14%, and 46.39% respectively) in the present study, which is in agreement with the

results of Mustafa M²² (male-46.7% and female - 50%) on Egyptian sacra and Letterman and Trotter's² study on American sacra but vary from the study of Kumar V¹⁹ where S4 was commonest location of sacral hiatal apex(male-46.6% and female -54.5%) in radiograph. In patient with LBP, hiatal apex at S2 was found in 10% in Mustafa's²² study, in 5.77% in study of Kumar V¹⁹ and in 13.77% in present study.

Black reported that in 7.7% of cases CEB failed due to the absence of sacral hiatus.²³ According to Sekiguchi et al. CEB failure might occur in 3-11% of cases due to anatomical abnormalities, among which sacral hiatus was absent in 4% of cases.¹⁷ In present study, SH was absent in 3.47% of male and 3.03% female dry sacrum, which was an important result as it may be caused by bony overgrowth and complete fusion of lamina of 4th and 5th sacral vertebra. In dry bone, absent hiatus was reported by Kumar V¹⁹ in 4.3% of male and 7.5% female South Indian sacrum, Mustafa²² in 13.7% of male Egyptian sacra, Nagar SK¹⁸ in 0.7% in Gujrat state, Senoglu et al.¹⁶ in Turkey found in 6.25% cases and 3.12% in central Indian region by Sinha MB.²⁴ The above data indicate that in present study in 70.06% of patient with LBP has an higher incidence of elongated sacral hiatal apex located above the level of S4, which will have very high rate of CEB failure.

Table 4: Incidence of level of apex of sacral hiatus by various authors in dry human Sacra irrespective of sex

	Deficient dorsal wall	S 2	S 3	S 4	S 5/ Absent
Kumar V ¹⁹ 2009	7.29%	2.04 %	12.83 %	72.01 %	5.83 %
Aggarwal A ⁸ 2009	3.50%	2.63 %	14.03 %	68.42 %	14.9 %
Suma HY ¹⁴ 2010	-	0.93 %	4.67 %	77.5 %	11.57 %
Shewale SN ¹⁵ 2013	0.98%	4 %	15 %	66 %	14.5 %
Bhattacharya S ¹² 2013	-	-	5 %	72 %	23 %
Sultana Q ¹³ 2014	2.06%	2.1 %	18.94 %	74.21 %	4.73 %s
Present study	2.07%	2.07%	19.53%	73.08%	3.25%

Table 5: Incidence of level of apex of sacral hiatus in X-Ray in present study compared with study of Kumar V¹⁹. (Male patient)

Vertebral level	Kumar V.(2009)	Present study
Deficient dorsal wall	40%	7.14%
2 nd Sacral vertebra	3.3%	12.86%
3 rd Sacral vertebra	10%	47.14%
4 th Sacral vertebra	46.6%	30.00%
5 th Sacral vertebra/absent	0%	2.86%

Table 6: Incidence of level of apex of sacral hiatus in X-Ray in present study compared with study of Kumar V¹⁹. (Female patient)

Vertebral level	Kumar V.(2009)	Present study
Deficient dorsal wall	27.2%	11.34%
2 nd Sacral vertebra	9%	14.43%
3 rd Sacral vertebra	9%	46.39%
4 th Sacral vertebra	54.5%	26.81%
5 th Sacral vertebra/absent	0 %	1.03%

CONCLUSION

The present study of variability in shape and size of dry human sacra and comparison with the radiogram with the patient with LBP will help the clinicians for successful caudal epidural anaesthesia and analgesia. In present study irregular, dumbbell and complete agenesis of sacral

hiatus was found in 13.02% where caudal epidural block is unfavourable. In 23.67% of dry sacra and 70.06% of patient with LBP, hiatus was present above the level of 4th sacral vertebrae. The above data indicate that there is positive association between backache and position of sacral hiatus above the S4 level or complete dorsal wall defect.

Fig 1: Various shapes of Sacral hiatus

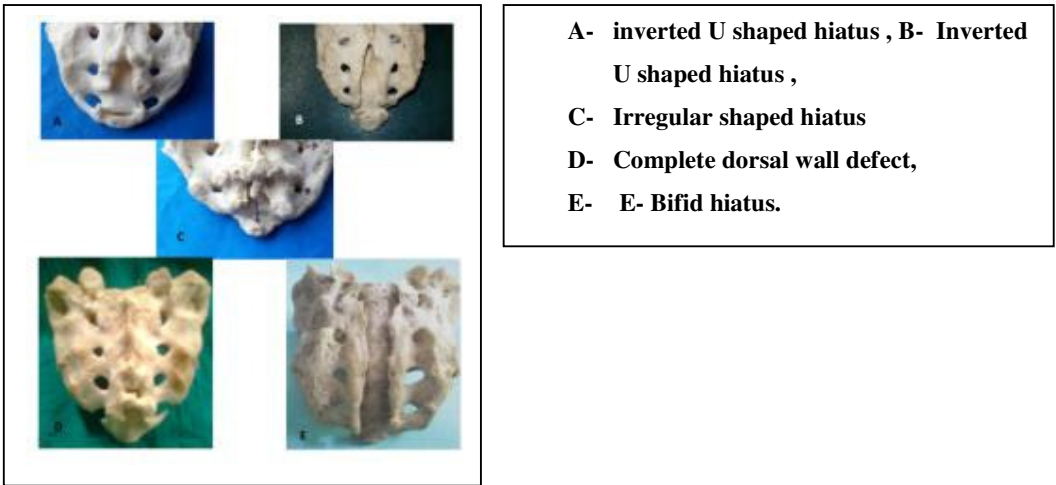
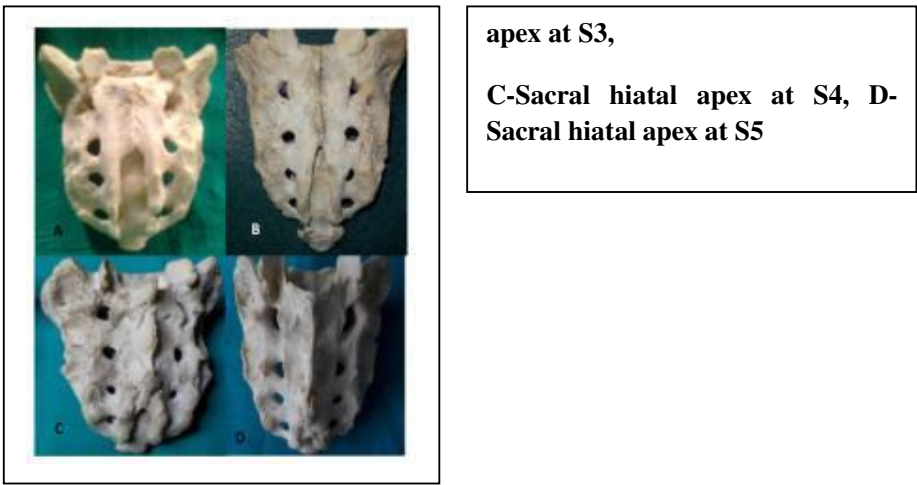
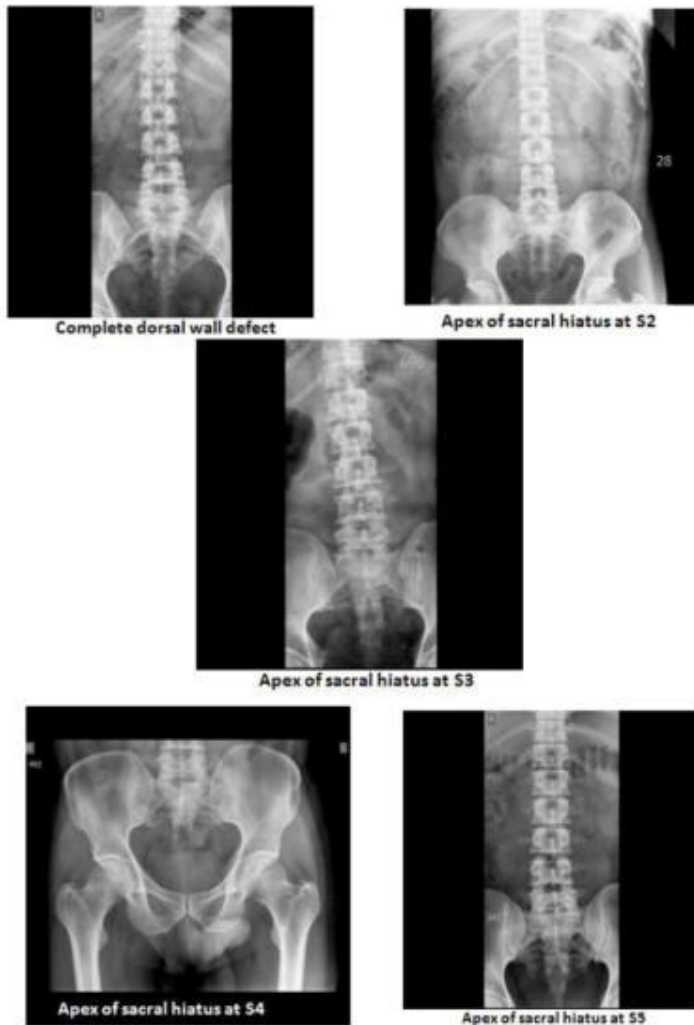


Fig 2: Various levels of apex of Sacral hiatus



Apex of Sacral hiatus on radiogram



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