Research Article

Morphological and morphometrical analysis of the sacroiliac joint with respect to sacral hiatus

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ABSTRACT

Introduction: According to human anatomy, the sacrum is a large bone that is triangular situated at the base of the spine. The sacrum is a complex structure that provides support for the spine and provides accommodation for the spinal nerves. The sacrum articulates with four bones such as it articulates with the last lumbar vertebra above, the coccyx below, and the ilium portion of the hip bones on either side. Sacral hiatus (SH) is an opening that is located inferior to the 4th or 3rd fused sacral spines or lower end of median sacral crest. **Materials and Methods:** In the present study, a total of 70 dry human sacrum bones of unknown sex and without any gross abnormality will be collected from the Department of Anatomy, Saveetha Dental College, Chennai, for evaluation. With the help of Vernier caliper and ruler, the measurements such as the length, breadth, and diameter of SH will be measured. The results obtained were analyzed, tabulated, and represented graphically. **Results:** Average diameter of auricular surface of sacrum on the right side was 43.52 ± 1.91 mm and on the left side was 44.25 ± 2.63 mm in males. Average diameter of auricular surface of sacrum on the right and left side was 46.27 ± 2.73 mm and 46.9 ± 1.58 mm, respectively, in females. Mean length of SH was 27.22 ± 4.13 mm. Mean breadth was 9.17 ± 2.65 mm. Mean depth was 4.36 ± 1.57 mm. **Conclusion:** There have been numerous studies linked to the reliability of sex estimation through the quantitative assessments of sexual dimorphic traits of the sacrum. With the sacrum being designated as a portion of the pelvic girdle, which is a known reliable and frequently used means of estimating sex, the sacrum's location and function do imply that it may be also used in sex estimation.

KEY WORDS: Morphometry, Sacral hiatus, Sacrum, Sex determination, Sexual dimorphism

INTRODUCTION

According to human anatomy, the sacrum is a large bone that is triangular situated at the base of the spine. The sacrum is formed by the fusion of sacral vertebrae S1–S5 between 18 and 30 years of age.[1] The sacrum is a complex structure that provides support for the spine and provides accommodation for the spinal nerves. The sacrum articulates with four bones. It articulates with the last lumbar vertebra above, the coccyx below, and the ilium portion of the hip bones on either side. Sacral hiatus (SH) is an opening that is located inferior to the 4th or 3rd fused sacral spines or lower end of median sacral crest. The SH contains lower sacral and coccygeal nerve roots, filum terminale externa, and fibrofatty tissue and covered by superficial posterior sacrococcygeal ligament which is attached to the margins of the hiatus and the deep posterior sacrococcygeal ligament which is attached to the floor of SH.[2]

The sacroiliac joint is the joint between the sacrum and the ilium bones of the pelvis. The two bones are connected by strong ligaments. The sacroiliac joint is strong that helps in supporting the entire weight of the upper body. The sacroiliac joint is synovial plane joint. The joint has irregular elevations and depressions that produce interlocking of the two bones. The human body has two sacroiliac joints, one on the left and one on the right that often match each other but is highly variable from person to person.[3] Sacroiliac joints are paired C-shaped or L-shaped joints capable of a small amount of movement that is formed between the auricular surfaces of the sacrum and the ilium bones. The joints are covered by two different kinds of cartilage; the sacral surface has hyaline cartilage and the iliac surface has fibrocartilage.[4] The sacroiliac

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joint stability has to be maintained. A combination of some bony structure and very strong intrinsic and extrinsic ligaments helps in maintaining the stability of the sacroiliac joint.[5] The sacroiliac joint space is usually 0.5–4 mm.[6] The sacroiliac joint's surfaces are flat or planar in early life. The sacroiliac joint's surfaces lose their planar or flat topography as we start walking and develop distinct angular orientations. They also develop a depression along the sacral surface and an elevated ridge along the iliac surface.[7]

Both the sacroiliac joints formed between the auricular surfaces of the sacrum and the two hip bones are amphiarthroses, almost immobile joints enclosed by very taut joint capsules. This capsule is strengthened by the ventral, interosseous, and dorsal sacroiliac ligaments.[8] The transfers of the load from the trunk of the body to the lower extremities are also successfully carried by the sacroiliac joints. A biochemical investigation explains that the increased motion of the sacroiliac joint results in greater stress across the sacroiliac joint due to the posterior lumbar spinal fusion.[9] The knowledge of anatomical variations of sacroiliac joint with SH can help in improving the reliability of the caudal epidural block and other related anesthetic procedures during surgery.[10]

MATERIALS AND METHODS

In the present study, a total of 70 dry human sacrum bones of unknown sex and without any gross abnormality will be collected from the Department of Anatomy, Saveetha Dental College, Chennai, for evaluation. With the help of Vernier caliper and ruler, the measurements such as the diameter of the auricular surface of sacral bone, length of SH, breadth of SH, and depth of SH were measured. The results obtained were analyzed, tabulated, and represented graphically.

RESULTS

Figure 1 shows the estimation of diameter by measuring the length and breadth of auricular surface of sacrum (lateral view). Figure 2 shows the measurements of the length of SH, breadth of SH, and depth of SH (posterior view). The average diameter of auricular surface of sacrum on the right side was found to be 43.52 ± 1.91 mm and on the left side was 44.25 ± 2.63 mm in males. The average diameter of the auricular surface of sacrum on the right and left side was 46.27 ± 2.73 mm and 46.9 ± 1.58 mm, respectively, in females. Figure 3 shows the average diameter of auricular surface of sacrum on the right and left side in males and females. The length of SH was found to be 27.22 ± 4.13 mm. The average breadth (intercornual distance) was 9.17 ± 2.65 mm. The average depth (anteroposterior depth at apex of SH) was 4.36 ± 1.57 mm. The measurement of length, breadth, and depth of SH is shown in Figure 4.

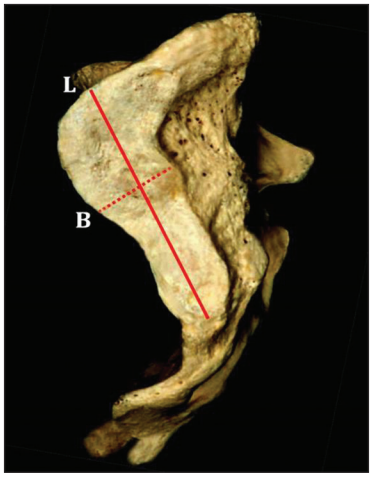

Figure 1: Estimation of diameter by measuring the length (L) and breadth (B) of auricular surface of sacrum (lateral view)

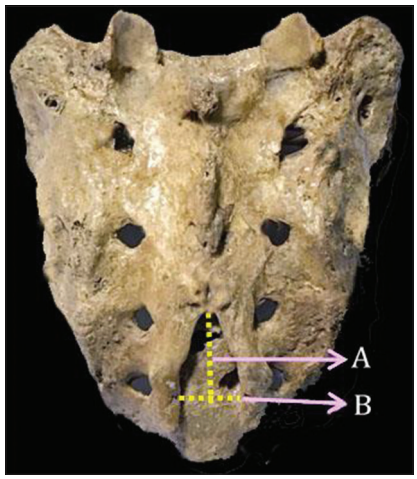

Figure 2: Measurements of the length of sacral hiatus (SH) (A), breadth of SH (B), and depth of SH of sacral bone (posterior view)

DISCUSSION

The present study was aimed to analyze a positive correlation between the diameters of auricular surface of sacroiliac joint with the dimensions of SH. However, there was no positive correlation between the two coordinates and both the parameters were appeared to be independent in reflecting the morphometrical traits of the sacral bone. The SH serves to be unique in deciphering the morphological and morphometrical variables of sacrum in determining its clinical implications. The most important implication is the epidural anesthetic nerve block through SH.

Administration of epidural anesthetic nerve block is performed through SH through posterior aspect. For successful application of epidural anesthetic procedure, a clear knowledge of the anatomy and morphometry of SH is very important.[11] Sacral hiatal agenesis or complete dorsal agenesis of

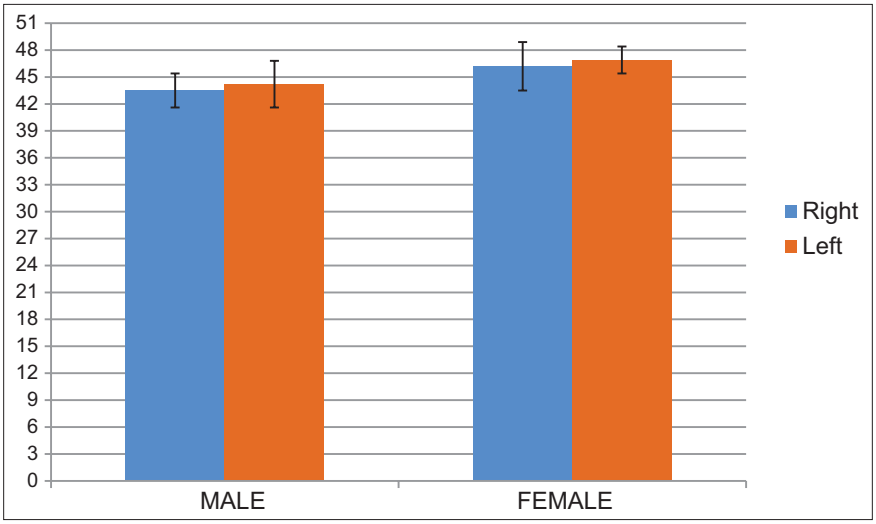

Figure 3: The average diameter of the auricular surface of sacrum on the right and left side in males and females. The values are expressed as mean ± SD

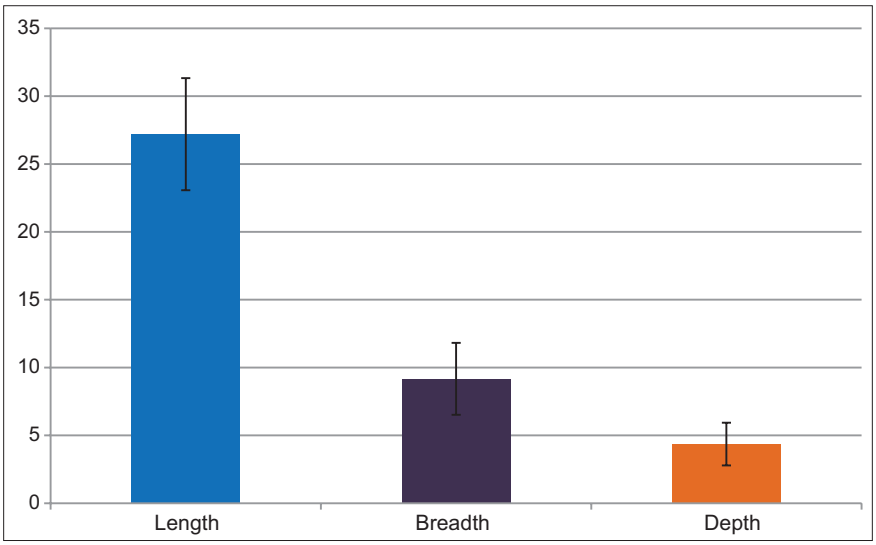

Figure 4: Measurement of length, breadth, and depth of sacral hiatus of sacral bone

sacrum causes failure of caudal epidural block in many clinical cases.[12] Such kind of rare anatomical variation in the SH may lead to failure of transpedicular and lateral mass screw placement.[13] The apex of the SH is a vital bony landmark in the successful administration of caudal epidural block, but it may be hard to palpate in most obese patients.[14] The importance of knowing the length of SH lies in the fact that while carrying out epidural anesthesia, after the needle pierces the sacrococcygeal membrane, it is moved forward for 2–3 mm cranially so that the entire bevel of the needle is in the sacral canal. The needle may pierce the spinal dura and may cause damaging effects if the length of sacral canal is too short or having similar variation in its dimensions.[15,16] Hence, studies similar to this provide a significant guiding protocol in the administration of epidural anesthetic nerve block without any damage to the patient.

CONCLUSION

Understanding the variations about sacral index along with reference to SH may throw light on the difficult procedures and practices involved in caudal epidural anesthetic block. Sacrum and SH showed morphometric variations in the present study. Understanding about this variation can improve the successful administration of the caudal epidural anesthesia. Identification and measurement of single bony landmark may not be helpful in locating SH. The equilateral triangle formed by the three bony points at sacrum may serve as a practical guide, which could be important in the detection of SH easily and increases the success rate of caudal epidural anesthesia.

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