

**ASSESSING THE DIMENSION OF SACRAL SPINAL  
CANAL FOR THECALOSCOPY USING MRI****ABHIMANYU PRADHAN\*<sup>1</sup> AND SUSHIL YADAV<sup>2</sup>**<sup>1</sup> Assistant Professor, Dept. of Medical Imaging Technology, School of Allied Health Sciences, Manipal University, Manipal<sup>2</sup> Assistant Professor (Sr. Scale) Dept. of Medical Imaging Technology School of Allied Health Sciences Manipal University, Manipal**ABSTRACT**

Endoscopy of the lumbar sub-arachnoidal space is named thecaloscopy, which has been used for diagnostic and therapeutic purposes. The understanding of the anatomic dimensions of this region is useful for the atraumatic use of flexible endoscopes. Furthermore, by using MRI the determination of anatomic values of the sacral spinal canal is possible without the use of cadaver measurements. MRI of lumbo-sacral region was performed on 25 male and 25 female patients who were referred by treating doctor. Measurements were performed on T2 weighted mid-sagittal image. The dimensions measured were sacral Spinal Canal (SSC), Sacral Spinal Process (SSP) and the width of sacral hiatus. The mean length of sacral spinal canal in its center for male was  $76.34 \pm 5.091$  (range 67.8-91) and for female was  $74.276 \pm 6.775$  (range 59.8-86.7). The mean length of the sacral spinal process for male was  $70.608 \pm 5.861$  (range 55.1-88.0) and for female was  $67.592 \pm 7.436$  (range 53.6-82.3). The width of sacral hiatus was  $17.32 \pm 1.730$  mm for male and  $17.08 \pm 1.868$  mm for female. Also the Lumbar Sacral Angle were measured whose mean for female was  $61.28 \pm 8.681$  and for male was  $53.24 \pm 6.488$ . Trans-sacral endoscopy though sacral hiatus is anatomically possible to perform because the endoscope can be introduced through the sacral hiatus over a length of sacral spinal canal. No further means needs to be undertaken during thecaloscopy, since the difference between sexes for the measured diameters is not statistically significant.

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## INTRODUCTION

At least once in their life two thirds of the adult populations are affected by back pain. This pain is usually described by the patients in lower lumbar spine and/or of the lumbosacral transition<sup>1</sup>. Back complaints, mainly in the form of lumbo-ischiatic pain, have turned to be the most expensive musculoskeletal diseases in the industrialized countries<sup>2</sup>. Therefore there is large scientific interest in further diagnostics and therapy of these patients. New diagnostic and therapeutic methods have been developed which are minimal invasive neurosurgical procedures, such as neuro-endoscopy and thecaloscopy<sup>3, 4</sup>. Endoscopy has a long history and is used extensively today following recent technical improvements. Endoscopy has been used in neurosurgery to examine ventricles, cisterns, and intra-arteries<sup>5</sup>. Endoscopy of the lumbar sub-arachnoid space is named thecaloscopy, which has been used for diagnostic and therapeutic purposes. According to the anatomical structures, namely the thecal sac and its anatomical position, the procedure is called thecaloscopy and the instrument is a thecaloscope. The understanding of the anatomic dimensions of this region is useful for the atraumatic use of flexible endoscopes. The aim of this study was the assessment of the dimension of Sacral Spinal Canal for Thecaloscopy using MRI, to evaluate the dimension of the sacral spinal canal. Furthermore, by

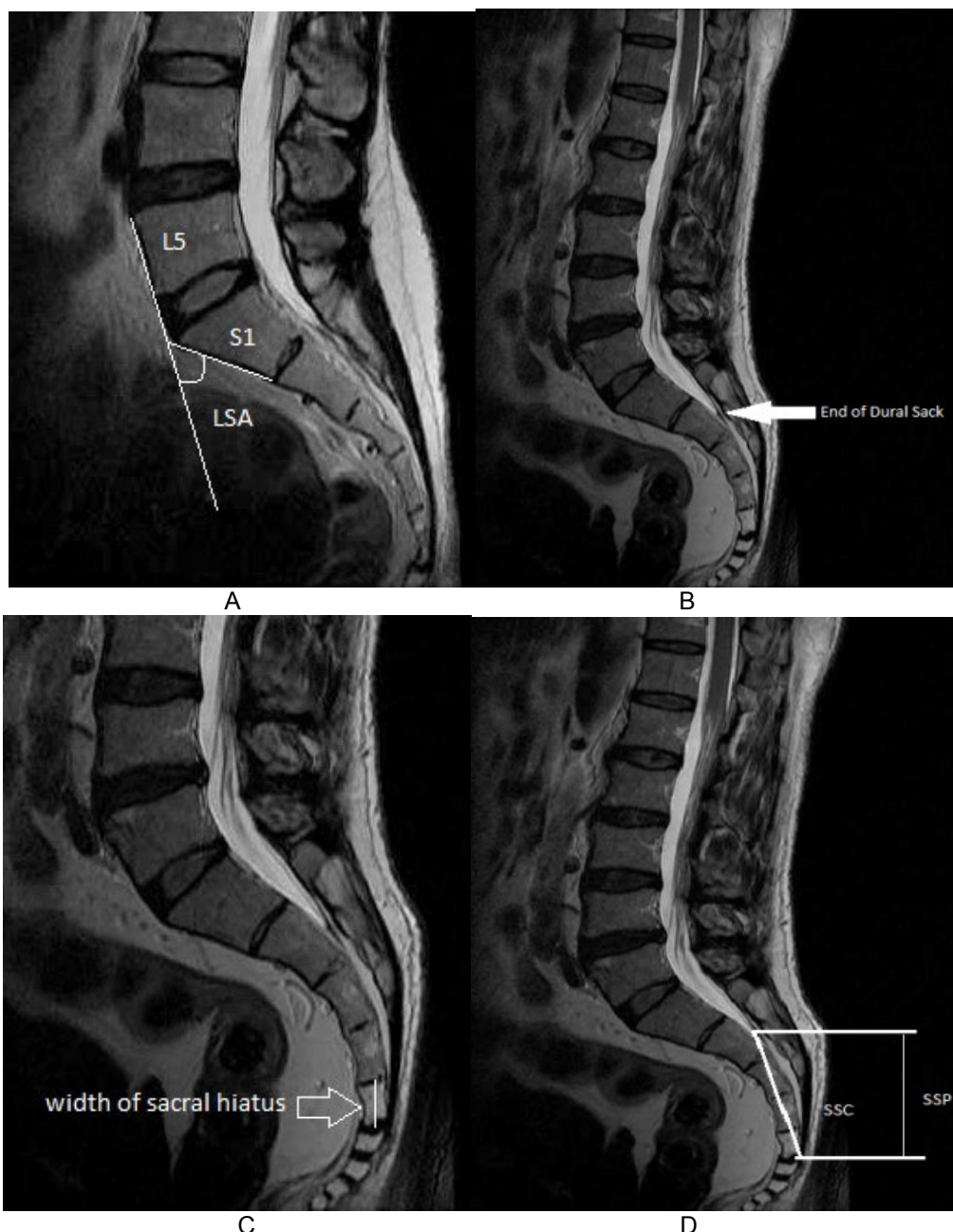
using MRI the determination of anatomic values of the sacral spinal canal is possible without the use of cadaver measurements.

## MATERIALS AND METHODS

Approval was acquired from ethical committee of Kasturba Hospital and institution research committee, School of Allied Health Sciences. The study design followed is Perspective observational design, carried out in MRI 1.5 T GE, Department Of Radio-diagnosis and Imaging, Kasturba Hospital, Manipal, Karnataka. Samples collected were 50, equally distributed to 25 males and 25 females of age group between 20-60 years who were referred by a physician for MRI of lumbar sacral spine. MRI scan of the lumbar sacral region was performed using routine sequences. Measurements were performed in T2 weighted mid-sagittal image. Metric data were collected in millimeters which includes SSC, SSP and width of sacral hiatus. The data from the end of dural sac were also collected and also the LSA were measured in degree. The obtained data were tabulated and statistically analyzed using SPSS 16.0 where maximum and minimum values, range, means, standard deviation and 95% Confidence Interval of the mean were calculated. A probability value < 0.05 is considered to be statistically significance using Independent T-test.

**Table I**  
**Definition of anatomic parameters of the body of the first sacral vertebra (S1)**

Sl.no	Parameters	Abbreviation	Definition
1	Lumbosacral angle	LSA	The angle between the anterior border of S1 vertebral body and that of the 5th lumbar vertebra.
2	Sacral spinal processes	SSP	The distance from the end of Dural sac to the inferior border of fifth sacral vertebra by drawing a horizontal line.
3	Sacral spinal canal	SSC	The distance from the end of Dural sac to the inferior border of fifth sacral vertebra.



**Figure I**  
**Mid-sagittal MRI images identifying: A) Lumbosacral angle (LSA), B) End of dural sac C) width of sacral hiatus. D) Sacral spinal canal (SSC) and Sacral spinal process (SSP)**

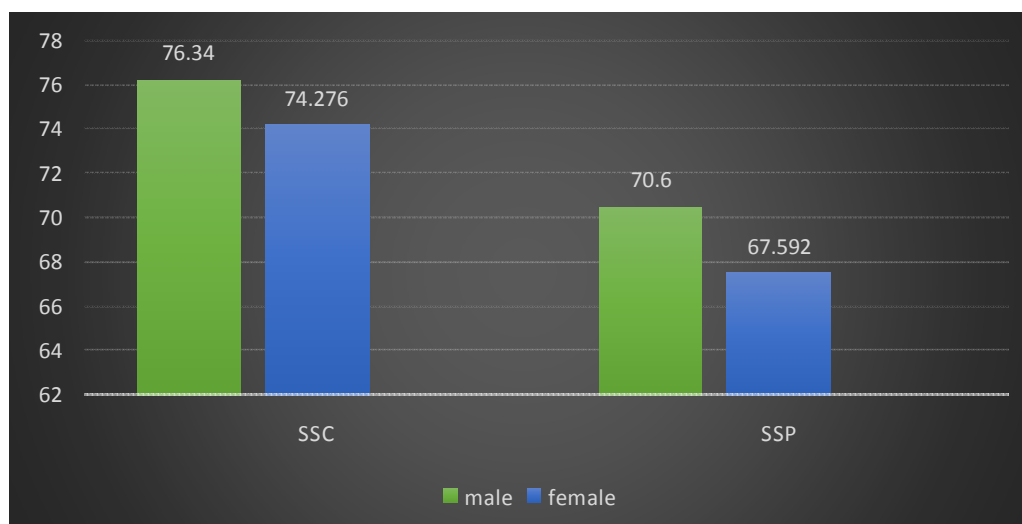
## RESULTS

There were 25 males with a mean age of 41 years (range 24-60 years) and 25 females with a mean age of 42 years (range 23-59 years). The investigated data was summarized in the table no: II. The mean of lumbo-sacral angle (LSA) for female was  $61.28 \pm 8.681$  and for male was  $53.24 \pm 6.488$ . The end of the dural sac was located in the end of S2 vertebral body for 10 patients (20%), for 14 patients (28%) at the middle of the S2 vertebra, 4 patients (8%) in mid S1 and for 23 patients (46%) it was

located in End of S1 vertebra. The mean length of sacral spinal canal in its center for male was  $76.34 \pm 5.091$  (range 67.8-91) and for female was  $74.276 \pm 6.775$  (range 59.8-86.7). The mean length of sacral spinal process for male was  $70.608 \pm 5.861$  (range 55.1-88.0) and for female was  $67.592 \pm 7.436$  (range 53.6-82.3). The width of sacral hiatus was  $17.32 \pm 1.730$  mm for male and  $17.08 \pm 1.868$  mm for female. The data clearly states that the length of sacral spinal process is smaller than the length of the sacral spinal canal in its center (figure no: II).

**Table II**  
**Statistical analysis of the investigated measurement and indices in male and female**

	Males (no. 25)			Females (no.25)			MGD	SE	CI	P-value
	Mean	SD	Range	Mean	SD	Range				
<b>LSA</b>	53.24	6.488	39-64	61.28	8.681	42-73	8.040	2.168	3.681to12.399	0.001
<b>SSC</b>	76.34	5.091	67.8-91	74.27	6.775	59.8-86.7	2.064	1.695	1.344to5.472	0.229
<b>SSP</b>	70.60	5.861	55.1-88.0	67.59	7.436	53.6-82.3	3.016	1.894	0.792to6.824	0.118
<b>Sacral hiatus</b>	17.32	1.730	13.2-20.6	17.08	1.868	14.7-21.1	0.240	0.509	0.784to1.264	0.640



**Figure II**  
**A histogram showing the difference in sacral spinal canal and sacral spinal process.**

## DISCUSSION

Different diagnostic and therapeutic procedures have been developed in the latter twenty years. Great interest lies in minimal invasive methods, particularly in endoscopic procedures, which include extradural and intradural exploration techniques<sup>3, 7</sup>. The LSA is considered as a theoretical reason for back pain<sup>6</sup>. Therefore in this study the LSA was measured to prove the anatomical possibility for trans-sacral endoscopy through the sacral hiatus. For the trans-sacral approach the length of all sacral spinal process, the end of dural sack and the width of the sacral hiatus are important. This study showed that the length of sacral spinal process is smaller than that of sacral spinal canal. Thus when the endoscope is directly employed under the sacral spinal process, it can be further manipulated without using the entire width of sacral spinal canal. Similar result was reported by Sofia<sup>6</sup> in her study. Warnke J P et al.,<sup>8</sup> conducted a study in which a 2.8-mm fiberoptic endoscope was used to insert into the thecal sac through transsacral approach. He found that the percutaneous insertion of a 2.8-mm endoscope into the

lumbar subarachnoid space was feasible without any neural structural damage. This study supports the result of the author as the width of the sacral hiatus (Table II) is much larger than the size of the endoscope used by the author. The dural sac ends at the level of S2 vertebra in 46% of the patients. The distance from the sacral hiatus to the duralsack's end, ranges from 35 to 75 mm, and is smaller if in cases the dural sac ends at a higher level. Finally the width of sacral hiatus is large enough in both sexes for the passage of the flexible endoscope. Also the LSA is easy to pass, because its angle range from 39° to 73°.

## CONCLUSION

This study has shown that MRI is a reliable method for the measurement of different dimensions of the sacrum and lumbar region. The dimensions measured were analyzed and hence this study was concluded that the trans-sacral endoscopy i.e., thecaloscopy, can be easily performed with the guidance of MRI.

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