International Journal of Research in Medical Sciences
Bhaumik M et al. Int J Res Med Sci. 2016 Jul;4(7):2883-2885
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20161970

Research Article

Study of variations of sagittal diameter of lumbar vertebral canal in population of Rajasthan, India

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Received: 17 May 2016
Revised: 22 May 2016
Accepted: 09 June 2016

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ABSTRACT

Background: The lumbar part of vertebral canal houses the cauda equina and narrowing of the bony ring of the canal, which may be developmental or acquired may lead to compression of these nerve roots and causes low back-pain. The increasing number of low back pain due to sedentary life style and other associated factors had provide a large number of radiographs, CT-scan, MRI Scans of lumbar spine. The present study was conducted in the western region of Rajasthan state to measure the sagittal diameter of lumbar canal in relation to distinguish difference in the variation in dimensions of both sexes. Aim is to evaluate the sexual differences in sagittal diameter of the lumbar vertebral canal.
Methods: Lateral view radiographs of 1000 patients (756 males and 289 females) between the age group of 20-60 years, with the history of low back pain reporting to the various outpatient departments of Neurosurgery, Orthopedics of S.M.S hospitals, Jaipur formed the material for the present study.
Results: There is a steady increase in sagittal diameter of lumbar spinal canal from L1 to L5 vertebrae. The dimensions of sagittal diameter of lumbar spinal canal in male population were higher than female population.
Conclusions: A steady increase is noted in antero-posterior diameter of canal in all lumbar vertebrae. The minimum values of antero-posterior diameter of canal is 17.68 mm for vertebra L1 and the maximum value is 21.98 mm at vertebra L5 in males. In females, the minimum value of antero–posterior diameter is 17.48 mm at L1 vertebra and the maximum value is population with male values are higher than the female values and showing highly significant changes at L1 vertebra.

Keywords: Lumbar spine, Lumbar vertebral canal, Inter-pedicular distance, Sagittal diameter

INTRODUCTION

The sagittal diameter of lumbar vertebra gives the standard diameter of lumbar spinal canal. Previously many researchers have measured sagittal diameter/anteroposterior diameter to arrive at standard diameters of lumbar spinal canal. The knowledge of normal diameter of lumbar spinal canal is very important for diagnosing lumbar spinal canal stenosis and also for performing spinal surgeries at lumbar level by Neurosurgeons and Orthopedicians. Huzinga et al performed the measurements on lumbar veterbrae obtained from Dutch cadavers.[1] They measured the mid-sagittal diameter from the center of the anterior surface of the laminae to posterior surface of vertebral body. This morphometry was of use in the recognition of stenosis. The lumbar part of vertebral canal houses cauda equina and narrowing of the bony ring of the canal, which may be developmental or acquired may lead to compression of these nerve roots and causes low back pain (Verbiest).[2] A vast majority of back pains though not accurately localized, have a limited distribution and arise from a

limited part of the spine (Kellgren).[3] Most of the complex spinal structures are inaccessible to detailed physical examination and thus it is necessary to developed ancillary methods of examining them. The introduction of radiographs, CT scan and M.R.I. scans provide accurate diameter of lumbar canal as well as the entire lumbar vertebra. The increasing number of low back pain due to the recent sedentary life style and other associated factors had provide a large number of radiographs and M.R.I./C.T. scans of lumbar spine. The importance of the size and shape of the spinal canal in relation to the occurrence of symptoms or cord or root compression, especially when spondolytic changes supervene have been recognized for some time. Most of the earlier work concerned with the cervical region but in more recent years a similar condition has been fully recognized in the lumbar region also (Esptein & Lavin, 1962).[4] They postulated that any antero-posterior diameter of less than 15 millimeters indicates narrowing of canal. Verbiest 2 was one of the first to define lumbar canal stenosis, characterized by shortened pedicle (Reduce I.P.D.) and a shallow sagittal (antero-posterior) diameter of vertebral canal. Other factors like Achondroplasia, Acromegaly, Paget's disease and Flurosis contribute increased narrowing of the spinal canal.

Therefore, this present study was conceived with the aim to evaluate the sagittal diameter of lumbar vertebral canal (from L1-L5) in Western Region of Rajasthan in relation to give an idea for the Neurosurgeons and Orthopedicians about the dimensions of general public for planning up their treatment and operative part.

METHODS

Lateral view radiograph of 1000 patients (756 male & 289 female) with the history of low back pain reporting to the outpatients department of Neurosurgery, Orthopeadics, Rehabilitation of S.M.S. hospitals, Jaipur formed the material for the current study. Only patients who were natives of Rajasthan state (born and brought up in Rajasthan) were included in the study. Whereas patients suffering from congenital spinal deformities like Achondroplasia, Tethered cord syndrome, spinal dysraphism, spilt cord malformations etc. and patients affected with spinal tuberculosis, spinal meningitis and even patients coming with spinal trauma with bony injuries, were excluded from the study. Also patients below 20 years of age and above 60 years of age, were excluded from the present study. The study design is mainly of descriptive type. The measurement of sagittal diameter of lumbar vertebral canal of one thousand patients was recorded with the lateral view radiographs. Students' test was used for statistical analysis. Antero-posterior diameter of lumbar spinal canal was measured from the middle of the back of the vertebral body to the base of the opposing spinous process as seen on lateral view radiograph.

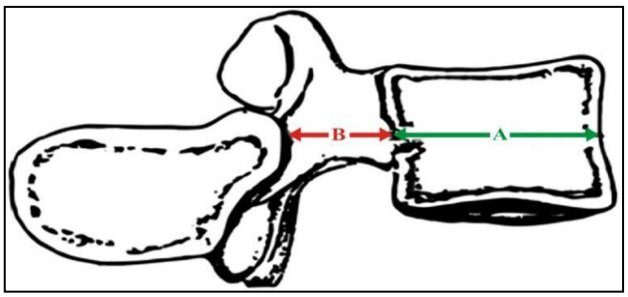
RESULTS

There is a steady increase in sagittal diameter of lumbar spinal canal from L1 to L5 vertebrae. The dimensions of sagittal diameter of lumbar spinal canal in male population were higher than female population.

Table 1: Mean+SD of sagittal diameter of lumbar vertebral canal in male and female.

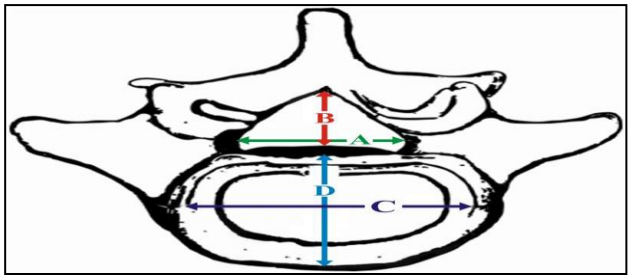
Vertebra	Male (mm)	Female (mm)	p-Value	Significance
L1	17.68±4.62	17.48±7.52	>0.05	NS
L2	18.20±4.10	17.73±3.78	>0.05	NS
L3	20.18±4.40	18.20±4.30	>0.001	HS
L4	20.90±5.97	19.50±4.54	<0.001	HS
L5	21.98±5.15	19.80±4.74	<0.001	HS

Figure 1: Photographs showing measurements of A-P. diameter of the vertebral canal on the radiograph with vernier calipers.



A- Antero-posterior diameter of the vertebral body. B- Antero-posterior diameter of vertebral canal.

Figure 2: Median sagittal view of fifth lumbar vertebra to show the diameters.



A- Interpedicular distance, B- Antero-posterior diameter of canal, C- Transverse diameter of vertebral body, D- Antero-posterior diameter of vertebral body.

Figure 3: Superior aspect of fifth lumbar vertebra.

DISCUSSION

The sagittal diameter of spinal canal in present study are showing an increasing order from L1 to L5 vertebrae (Table 1). The minimum antero-posterior diameter is noted for L1 vertebra 17.68 mm in males and 17.48 mm in females, while the maximum antero-posterior diameter of canal is 21.98 mm in males, and 19.80 mm for females for L5 vertebra. The antero-postero diameter of spinal canal for L1 and L2 vertebrae shows P value greater than 0.05 (P>0.05) and showing insignificant value, while for vertebrae L3, L4 and L5 shows (P<0.00a) highly significant variation between two sexes. The value regarding antero-posterior diameter of spinal canal in present study are in contrast with the values given by S. Eisenstein.[5] In this study the values of A-P diameter canal are in increasing order, but S. Eisenstein reported a decrease in A-P diameter of spinal canal for vertebra L2, L3, L4.[5] The implications were that this middle section of the lumbar vertebrae bears close examination in patients presenting with a spinal canal stenosis.

CONCLUSION

A steady increase is noted in antero-posterior diameter of canal in all lumbar vertebrae. The minimum values of antero-posterior diameter of canal is 17.68 mm for vertebra L1 and the maximum value is 21.98 mm at vertebra L5 in males. In females, the minimum value of antero–posterior diameter is 17.48 mm at L1 vertebra and the maximum value is population with male values are higher than the female values and showing highly significant changes at L1 vertebra.

ACKNOWLEDGEMENTS

Authors would like to Thanks Dr (Prof) Neelam Bapna, Dr (Prof) L K Jain, Dr Charu Taneja.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required as passed by Research Review board of Rajasthan University of health Sciences

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Cite this article as: Bhaumik M, Bhaumik U. Study of variations of sagittal diameter of lumbar vertebral canal in population of Rajasthan, India. Int J Res Med Sci 2016;4:2883-5.