Study of Lumbar Vertebral Canal in Pakistanis and Comparison with Other Races

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An osteometric study of the anteroposterior diameter of the lumbar vertebral canal of normal adult Pakistani males and comparison to Nigerians was done. Fifty complete sets of adult male lumbar vertebra were studied. In Pakistani the mean sagittal diameter was narrow at the level of L1, L3, L4 and wider at L2 and L5. The canal body ratio was maintained at 0.5 at all levels. Inferior vertebral notch maintained its ratio at 0.3 at all levels except at L2 it was 0.4. The diameter of vertebral canal is narrow in Pakistanis as compared to Nigerians.
Key words: Lumbar vertebral canal.

The backache and sciatica is a common problem in both rich and poor people of Pakistan. the stenosis of vertebral canal and intervertebral foramina is one of the causes of pain in the back and lower limbs on walking, weakness and paresthesia along the distribution of affected nerve roots. Verbiest[12] called this the lumbar spinal stenosis syndrome and suggested that it could result due to congenital narrowing of the canal. Eisenstein[4] has established that abnormality ;may involve transverse, sagittal or both diameters of the canal. Eisentein Larsen and Smith and Amonoor Koufi compiled normal values of sagittal diameters. They also reported age, racial and ethnic variation in the shape and dimension of canal in groups of caucasians, South African and Nigerian people.

The purpose of this study is to evaluate size of vertebral canal, body and intervertebral foramen in normal adult male Pakistani population, also to find out whether they differ from those of the other races.

Material & methods

The present study was based on a technique of measuring the diameters of osteological specimen. Hones and Thomson, subsequently adopted by Eisenstein, which gave accurate results. Fifty complete sets of adult male lumbar vertebrae aged between 25 and 60 years from osteological collection of the Department of Anatomy. King Edward Medical College, Lahore were studied. The medical histories of all subjects were not obtained but it was ensured that the people who had died of chronic skeletal disorders in bone diseases were not included.

The neural canal of each vertebra was examined. The shapes of the canal and intervertebral foramen were noted. The midsagittal diameter of the canal, vertebral body and inferior vertebral notch were made using a sliding vernier calliper. The midsagittal diameter of the canal was measured at the point where the canal was narrowest, near the upper border at the level of a slight interior bulge in a deep surface of the posterior wall of the canal. The anterior posterior diameter of the vertebral body was measured mid-waist level where it was narrowest, while the anterior posterior diameter of the inferior vertebral notch was taken at the maximum horizontal distance between the posterior surface of the lowest part of the vertebral body and the deep surface of the lamina.

Observations

The results of measurements of mid-sagittal diameter of the vertebral canal in male are present in Table 1,Fig.1

Mean values, standard deviations and co-efficient of variation were calculated. The sagittal diameter was narrow at the level ofL1, L3, L4 and at L2 and L5. The inter segmental differences in mid sagittal diameters between L1, L2, L3, L3 was 0.34 and 0.2mm whilst difference between L4/L5 was about 0.4mm.

In order to correlate the size of the vertebral canal in Pakistani population with those of other black population, the mean mid-sagittal diameters obtained in the present study were compared with those of two different populations of black South Africans and Nigerians. It was broadly concluded from the data available. (Table 2) that the mean mid-sagittal diameter of both Nigerian and South Africans subjects was greater as compared to Pakistanis.

Table 2. Comparisons between mean measurements of sagittal diameter of lumbar canal in the present study and the study of Nigerians and South Africans.

Vertebra Level	Pakistan(mm)	Nigerian(mm)	South African (mm)
L1	14.44	16.6	16
L2	14.78	15.8	15
L3	14.35	15.6	15
L4	14.35	15.6	15
L5	14.85	16.0	16

Mid Sagital Diameter of the Body: There was steady increase in mean mid sagittal diameter of vertebral body from the level of the first number to 5th number Table 1.

Canal Body Ratio

The size of the vertebral body varied proportionately with the built of the individual, so there would be corresponding variations of the height of the pedicles and the width of the laminae. In order to find out the relationship between the vertebral canal and body a comparison was made by finding the ratio between the mean analytic anterioposterior diameter of the canal and the mean analytic anterior-posterior diameter of the vertebral body at the various vertebral levels, the result showed that at the size of the vertebral body changed, the sagittal diameter of the canal also varied, but maintaining the ratio of 0.5 atL1, L2,L3,L4 and L5 (Table 3).

Table 3. Ratios of mean sagittal diameter of lumbar spinal canal to the mean anteroposterior (AP) diameter of vertebral bodies in males.

Vertebra Level	Mean Sagittal Diameter of the vertebral canal (mm)	Mean AP Diameter of the body (mm)	Ratio
L1	14.44	26.59	0.5
L2	14.78	28.35	0.5
L3	14.58	28.14	0.5
L4	14.35	30.58	0.5
L5	14.85	32.11	0.5

Inferior Vertebral Notch/Body Ratio

By calculating the ratio between diameter of notch and anterior-posterior diameter of the body (Table 4),the inferior vertebral notch maintained the ratio of 0.3 at all levels except at L2 where a ratio ofl;0.4 was maintained.

The upper andlower95% limit of the normal values was worked out using the formula given by Badford Hill. These range which varied narrowly especially at L4 and L5.

Discussion

Morphometric studies of Lumbar vertebral body, canal and notch give information regarding age, sex and racial difference, Huizinga et al, Hinck et al, Eisenstein Amonoo Kuofi, but Larsen and Smith were unable to confirm the observations of Hinck et al. The present results confirmed that there are differences in the size of adult canal between Pakistani and Nigerian Amino Koufi.

There is also difference in shape and size of the canal between South African black population, Eisenstein and the present study.

The hour glass shape of sagittal diameter of the canal was reported by Hizingat et al, Hinck et al and Sand, Larsen and Smith, Amonoo-Koufi such appearance is not seen in Pakistanis and maximum diameter is found at L4.This is similar to Nigerian females.

The diameter of vertebral canal is narrow in Pakistanis than Nigerian and South Africans.

In our study wide anteroposterior diameter is at the level ofL2 but in other studies it is at the level L5.It may be due to racial difference in gradual transition from immobile thoracic region to mobile lumbar segment. In addition this level also houses the lower end of the lumbar enlargement of spinal cord and the conus medullaris. The width of the canal at this level may be a reflection not only of the size of contents but also of adaptation to ensure protection to the contents during complex movements of this transitional region. At this level, there is also change in curvature of spine from thoracic convexity to lumbar concavity. As the spinal cord would tend to be displaced dorsally in erect posture therefore the diameter has to be capacious enough to accommodate it.

The sagittal diameter at L5 is larger as compared to other levels in present study but there is greater variability in other studies.L5 is the site of lumbosacral angulation it may be an adaptation to accommodate the sacral nerve roots, there would bow string during angular movement between mobile lumbar segments and immobile sacrum at lumbosacral junction.

Table 1. Sagittal diameters, standard diameters and coefficient of variation of vertebral body, vertebral canal and inferior vertebral notch and adult Pakistani males.

Vertebra Level	Mean Sagittal Diameter of body(mm)	Standard Deviation	Coefficient of Variation	Mean Standard Diameter of Vertebral Canal (mm)	Standard Deviation	Coefficient of Variation (%)	Mean Standard of Inferior Vertebral Notch(mm)	Standard Deviation	Coefficient of Variation (%)
L1	26.59	3.88	14.6	14.44	2.75	19.1	9.13	1.67	11.8
L2	28.35	2.47	8.7	14.78	2.03	14.5	10.19	1.81	17.7
L3	28.14	2.65	9.4	14.58	2.19	12.0	9.82	1.05	10.6
L4	30.58	2.78	9.1	14.35	2.23	15.6	10.06	1.01	10.8
L5	32.11	2.63	8.1	14.85	2.68	18.7	10.09	1.27	12.6

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