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Osteological Study of Lumbar Vertebrae in Population Of Gwalior Region

Dr. Sudhir Saxena [1], Dr. Rajendra Singrolay[2]
Associate Professor, Department Of Anatomy Gajra Raja Medical College, Gwalior (MP)
Associate Professor, Department Of Anatomy Gajra Raja Medical College, Gwalior (MP)
Corresponding auther: Dr. Sudhir Saxena

Abstract *–Introduction: The Lumbar Vertebrae Are Five Vertebrae Between The Rib Cage And The Pelvis. They Are Characterized By The Absence Of The Foramen Transversarium. This Study Conducted To Measures The Bony Vertebral Dimensions And To Set The Normal Limits In Assessing The Lumber Stenosis. Aim: Study Of Lumbar Vertebrae In Population Of Gwalior Region. Material And Methods: 300 Lumbar Vertebrae From L1 To L5 Were Taken For The Measurement Of Different Dimensions From The Anatomy Department Of GR Medical College Gwalior. Result And Discussion: The Mean Transverse And Anteroposterior Diameter Of Vertebral Body And The Spinal Canal Were Minimum In The L1 And Gradually Increases To L5 In Both The Sexes. The Parameters Are Used For The Measurement Of Spinal Index Of Jones And Canal Body Ratio. Conclusion: Study Shows Regional Variation In The Parameters Of Lumbar Vertebrae.*

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I. Introduction :

The Vertebral Column Forms The Central Axis For Weight Bearing Of The Body And Help To Protect The Spinal Cord. The Lumbar Part Of The Vertebral Canal Lodges The Conus Medullaris And The Cauda Equina Within A Dural Sac. The Bony Wall Of The Canal Is Unyielding And Therefore An Abnormal Spinal Canal Stenosis At This Level May Lead To Compression Of The Nerve Roots. This Produces A Wide Spectrum Of Symptoms, Ranging From Low Backache To Neuro logical Manifestations.

The Vertebral Column Bears The Weight Of The Trunk And Upper Limbs And Transmits It To The Lower Limbs. This Weight Transmission, Subjects The Vertebral Column To Vertical Compressive Forces, The Magnitude Of Which Gradually Increases From The Cervical To The Lumbar Vertebral Levels. This Mechanism Substantiates The Gradually Increasing Size Of The Vertebrae From Cervical To Lumbar Regions. [1] Anatomical Studies Have Been Conducted In Different Ethnic Groups To Measure The Size Of The Bony Vertebral Canal And To Determine The Normal Limits Which Will Serve As Guidelines In Assessing Pathological Canal Stenosis. [2] Studies Have Also Been Done To Determine The Transverse And Sagittal Diameter Of The Vertebral Canal From X-Rays Of Asymptomatic Patients. [3],[4] This Baseline Data Is Necessary To Diagnose Lumbar Canal Stenosis, Especially The Developmental Forms.

II. Material And Methods :

Sixty Complete Sets Of Lumbar Spine (Three Hundred Lumbar Vertebrae) Of Adult Age Group Of Both The Sexes 30 Each, Collected From The Anatomy Department Of Gajra Raja Medical College And Other Colleges Of The MP. Specimens Showing Evidence Of Chronic Bone Disorders Or Specimens Showing Osteophytes Were Excluded. Only Normal Appeared Specimens Were Included For The Study. Vernier Caliper Was Used For Various Measurements Of The Lumbar Vertebrae.

The Following Measurements Were Taken Of Each Vertebra.

1) The Transverse Diameter Of Vertebral Body: From Minimum Transverse Distance At The Mid Vertebral Label. (Fig.No. 1)
2) Transverse Diameter Of Spinal Canal : From Minimum Distance Of The Medial Surface Of The Roots Of The Vertebral Arch. (Fig.No. 2).
3) Anteroposterior Diameter Of The Vertebral Body: From Mid Waist Level Of The Vertebral Body.(Fig No 3).
4) Anteroposterior Diameter Of The Spinal Canal : From The Midpoint Of Vertebral Arch And The Posterior Margin Of The Body. (Fig. No. 4)

From The Above Measurements Canal Body Ratio (C/B Ratio) And The Spinal Index Of Jones Were Obtained.

a) The Canal Body Ratio (C/B Ratio) [5]

Transverse Diameter Of Spinal Canal / The Transverse Diameter Of Vertebral Body

b) The Spinal Index Of Jones [6] – This Was Described By The Jones RAC And Thomson JLC In 1968. It Is A Ratio Of Spinal Canal And Vertebral Body Dimensions.

The Formula Of The Spinal Index Of Jones Is

I = CAP X C Trans/ B AP X B Trans

I =The Spinal Index Of Jones

CAP =Anteroposterior Diameter Of The Spinal Canal

C Trans =Transverse Diameter Of Spinal Canal

B AP =Anteroposterior Diameter Of Vertebral Body

B Trans =Transverse Diameter Of Vertebral Body

The Range, Mean, And Standard Deviation (SD) Of Measurement Of Lumbar Vertebrae Were Calculated. Maximum And The Minimum Limits Were Calculated By Using SD And From Mean Value. This Gives The Calculated Range. The Difference Was Statistically Significant Between The Means Of Parameters Studied For Male And Female Vertebrae, The "P" Value Was Calculated By Using The "Z" Test. The Observations Are Tabulated Below.

III. Results

The Results Of Transverse And Anteroposterior Diameter Of Lumbar Spinal Canal And Vertebral Body From L1 To L5 Are Shown In Table No.1 And 2 Along With This Table No. 1 Also Showing Canal Body Ratio. The Spinal Index Of Jones Is Given In The Table No. 3. Spinal Stenosis And The Intraspinal Tumor Values At Each Label Are Shown In The Table No.4.

IV. Discussion

Lumbar Spinal Stenosis Is A Common Condition In Patients And Also One Of The Most Common Reasons To Perform Spinal Surgery. Disc Degeneration, Facet Degeneration And Hypertrophy, And Ligamentum Flavum Hypertrophy And Calcification Usually Participate In The Genesis Of A Stenotic Condition In The Elderly [6]. Knowledge Of Normal Values Of Canal Body Ratio In Various Ethnic Groups Could Be Of Importance In Detecting Isolated Segmental Changes. In The Present Study Attempt Has Been Made To Determine Standard Normal Canal Body Ratio As A Preliminary To Clinical Investigation Of Transverse Spinal Canal Stenosis As Well As Anteroposterior Spinal Canal Stenosis.

Table No. 1) Transverse Diameter Of Spinal Canal And Vertebral Body With Calculated Canal Body Ratio.

		Transverse Diameter Of Spinal Canal				**Transverse Diameter Of Vertebral Body**				
Level	**Sex**	**Mean**	**Range**	**SD**	**P Value**	**Mean**	**Range**	**SD**	**P Value**	**Canal Body Ratio**
L1	**M**	**22.20**	**16-26**	**2.40**	**< 0.001**	**36.26**	**32-42**	**2.31**	**< 0.001**	**.61**
	F	**20.10**	**14-25**	**2.51**		**33.46**	**28-38**	**2.63**		**.59**
L2	**M**	**22.70**	**18-26**	**2.26**	**< 0.001**	**39.44**	**33-44**	**2.49**	**< 0.001**	**.58**
	F	**20.42**	**14-25**	**2.46**		**35.44**	**28-41**	**2.86**		**.57**
L3	**M**	**23.60**	**20-27**	**1.90**	**< 0.001**	**40.28**	**34-45**	**2.24**	**< 0.001**	**.56**
	F	**21.86**	**15-25**	**2.28**		**37.46**	**30-43**	**2.88**		**.54**
L4	**M**	**24.88**	**21-29**	**2.02**	**< 0.001**	**\ 42.76**	**37-47**	**2.44**	**< 0.001**	**.58**
	F	**23.14**	**18-26**	**1.80**		**39.88**	**32-45**	**2.92**		**.56**
L5	**M**	**27.44**	**21-32**	**2.56**	**< 0.05**	**45.68**	**41-51**	**2.80**	**< 0.001**	**.56**
	F	**25.76**	**20- 29**	**2.16**		**41.88**	**35-48**	**2.98**		**.59**

SD: Slandered Deviation; P: Provability

Table No. 2) Anteroposterior Diameter Of Spinal Canal And Vertebral Body .

		Anteroposterior Diameter Of Spinal Canal				**Anteroposterior Diameter Of Vertebral Body**			
Level	**Sex**	**Mean**	**Range**	**SD**	**P Value**	**Mean**	**Range**	**SD**	**P Value**
L1	**M**	**16.84**	**13-21**	**1.60**	**< 0.05**	**30.00**	**27-34**	**2.20**	**< 0.001**
	F	**15.90**	**13-21**	**1.72**		**28.2**	**23-31**	**2.30**	
L2	**M**	**15.86**	**12-20**	**1.86**	**NS**	**30.54**	**27-34**	**2.24**	**< 0.001**
	F	**15.20**	**12-21**	**1.80**		**28.86**	**23-31**	**2.60**	
L3	**M**	**15.24**	**11-18**	**1.79**	NS	**31.86**	**28-35**	**2.08**	**< 0.001**
	F	**14.40**	**11-18**	**1.65**		**28.94**	**23-32**	**2.76**	
L4	**M**	**14.66**	**10-17**	**1.87**	**< 0.05**	**32.10**	**29-38**	**2.38**	**< 0.001**
	F	**13.64**	**10-17**	**1.67**		**29.30**	**23-33**	**2.78**	
L5	**M**	**14.10**	**10-16**	**1.78**	**< 0.05**	**32.78**	**29-40**	**2.44**	**< 0.001**
	F	**12.92**	**10-16**	**1.70**		**30.06**	**23-35**	**3.13**	

SD: Slandered Deviation; P: Provability; NS: Not Significant

4(A) Transverse Diameter Of Spinal Canal

It Was Found That Transverse Diameter Was Minimum At L1 And Has Gradual Increasing Trends Upto L5 In Both The Sexes, With Lower Mean Values In The Female Compared To Males And This Difference Was Highly Significant. Values Lesser Than The Limits Of Calculated Range Are Suggestive Of The Lumbar Canal Stenosis. Values More Than The Upper Limits Of Calculated Range Age Suggestive Of The Intraspinal Tumors.

Table No.3 The Spinal Index Of Jones

		Spinal Index Of Jones		
Level	Sex	Mean	SD	P Value
L1	M	1:2.98	.58	<.05
	F	1:2.74	.45	
L2	M	1:3.40	.62	
	F	1:3.14	.50	<.05
L3	M	1:3.60	.66	
	F	1:3.30	.56	<.05
L4	M	1:3.66	.68	
	F	1:3.8	.58	<.05
L5	M	1:3.88	.70	
	F	1:3.44	.61	<.01

SD: Slandered Deviation; P: Provability

4(B) Transverse Diameter Of Vertebral Body

According To The Table No 1 Transverse Diameter Of Vertebral Body Gradually Increases From The L1 To L5 In Both The Sexes But The Diameter Are Larger In Males As Compared To Females And The Difference Between The Means Of The Two Were Statistically Significant.

4(C) Canal Body Ratio

As The Size Of Vertebral Body Changes ,The Transverse Diameter Of The Canal Also Varies Study Result Also Showing The Same And Having A Approximate Ratio Of .06 At Each Level In Both Male And Female. Any Deviation Of Canal Body Ratio From .06 To Any Side Indicates The Possibility Of Intraspinal Tumor. Measurement Of This Ratio In The Individual Will Also Helpful In Identifying The Stenosis Or Intraspinal Tumor Or In Normal Range**.**

4(D) Anteroposterior Diameter Of Spinal Canal

Table No 2 Clearly Explains The Gradual Decrease In The Spinal Canal In Both The Sexes. It Shows The Transition Of Spinal Canal From Lumbar Type To The Sacral Type. These Values Helps To Identify The

Stenosis Or Intraspinal Tumor. Values Less Than The Lower Limits Of The Calculated Range Will Help To Identify Stenosis While Greater Values For Intraspinal Tumor**.**

Table No 4. Values Showing Spinal Stenosis And Intraspinal Tumor At Each Vertebral Label In Both The Sexes

Transverse Diameter Of Spinal Canal				**Anteroposterior Diameter Of Spinal Canal**		**Spinal Index Of Jones**	
Lavel	**Sex**	**Spinal Stenosis**	**Intraspinal Tumor**	**Spinal Stenosis**	**Intraspinal Tumor**	**Spinal Stenosis**	**Intraspinal Tumor**
L1	**M** **F**	**< 15.20** **< 12.42**	**> 29.36** **> 27.46**	**< 12.00** **< 10.54**	**> 25.68** **> 24.20**	**> 1:4.82** **> 1:4.22**	**<1:1.26** **<1:1.44**
L2	**M** **F**	**< 16.21** **< 13.08**	**> 29.38** **> 27.54**	**< 11.30** **< 10.36**	**> 25.28** **> 23.76**	**> 1:5.24** **> 1:4.76**	**<1:1.60** **<1:164**
L3	**M** **F**	**< 18.38** **< 15.12**	**> 29.36** **> 28.30**	**< 10.24** **< 9.78**	**> 24.20** **> 23.16**	**> 1:5.54** **> 1:4.82**	**<1:1.72** **<1:1.66**
L4	**M** **F**	**< 18.44** **< 17.15**	**> 31.44** **> 29.38**	**< 9.68** **< 9.22**	**> 23.78** **> 22.18**	**> 1:5.66** **> 1:5.10**	**<1:1.78** **<1:1.68**
L5	**M** **F**	**< 18.94** **< 18.40**	**> 35.55** **> 32.18**	**< 8.78** **< 8.12**	**> 21.42** **> 20.86**	**> 1.5:86** **> 1.528**	**<1:1.98** **<1:1.72**

4(E) Anteroposterior Diameter Of Vertebral Body –

Anteroposterior Diameter Of The Vertebral Body Increases From The L1 To L5 In Both Males And Females And The Difference Between The Means Of Both Sexes Is Statistically Significant.

4(F) Spinal Index Of Jones –

Values Of This Index Increases From The L1 To L5 In Both Males And Females. The Mean Values Are Higher In Males Than Females And Difference Was Statistically Significant. This Index Helps Us About The Information Of Proportions Of Transverse Diameter As Well As Anteroposterior Diameters Of Body And Spinal Canal.

V. Conclusions –

From The Present Study It Is Clear That There Is Statistically Significant Difference In The Mean Values For Males And Females Showing Sexual Dimorphism. There May Be Marked Difference Between The Mean Values Of Various Geographical Areas. It Needs Further Study . The Present Study May Be Helpful For The Detection Of Conditions Like As Spinal Stenosis And Intraspinal Tumor.

Fig No. 1 Transverse Diameter Of Vertebral Body

Fig No.2 Transverse Diameter Of Spinal Canal

Fig No. 3 Anteroposterior Diameter Of Vertebral Body

Fig No. 4 Anteroposterior Diameter Of Spinal Canal

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