e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(3); 512-515

Original Research Article

Retrospective Comparative Evaluation of Thickness of Ligamentum Flavum in Normal and Stenosis of Lumbar Vertebrae

Pradeep Kumar[1], Alpana Pathak[2], Rupesh Kumar Srivastava[3], Sanjeev Suman[4], V. S. Prasad[5]

[1]Senior Resident, Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, Bihar, India

[2]Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, Bihar, India

[3]Tutor, Department of Anatomy, IMS BHU, Varanasi, Uttar Pradesh, India

[4]Assistant Professor, Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, Bihar, India

[5]Professor and HOD, Department of Radiodiagnosis, Patna Medical College and Hospital, Patna, Bihar, India

Received: 09-01-2024 / Revised: 14-02-2024 / Accepted: 20-03-2024
Corresponding Author: Dr. Alpana Pathak
Conflict of interest: Nil

Abstract

Background: Ligamentum Flavum (LF) wraps around the medial aspect spinal articulation and is composed more elastic than collagen fibres, hence it's yellow in colour. Its elasticity diminishes with age and there is loss of elastic fibres and a concomitant increase of collagen fibres. The study compared the thickness of the LF between individuals with normal spinal conditions and those with lumbar spinal stenosis (LSS). The goal was to investigate variations in LF thickness and asymmetry observed in CT images, taking into account the size of the associated vertebral bodies across different ages and sexes.

Method: The study involved measuring the thickness of the Ligamentum Flavum (LF) in 50 individuals with lumbar spinal stenosis (LSS) and 50 controls visiting Patna Medical College and Hospital, Patna, Bihar India, for one year, using CT images at the levels of L3-L4, L4-L5, and L5-S1.

Analysis: A 't' test and P-value analysis were performed to compare the results between the LSS and control groups.

Results: The cross-sectional area of the dural sac was significantly smaller in the LSS group compared to the control group: at L3-L4 (control: mean 132.5, SD±46; LSS: mean 65.2, SD±23), L4-L5 (control: mean 133.3, SD±44; LSS: mean 48.3, SD±25), and L5-S1 (control: mean 136.2, SD±46; LSS: mean 91.2, SD±36). The thickness of LF at L3-L4, L4-L5, and L5-S1 showed significant differences between the LSS and control groups ($P<0.01$). Additionally, LF thickness in both sexes of the control group also showed significant differences ($P<0.01$).

Conclusion: This empirical retrospective suggests that measuring LF thickness can be diagnostically valuable in assessing lumbar spinal stenosis across different ages and genders.

Introduction

The Ligamentum Flavum (LF) plays a crucial role in the structure of the spine. It is a yellow, elastic ligament that connects the laminae of adjacent vertebrae, spanning from the C2 vertebra to the S1 segment. Lumbar spinal canal stenosis is a prevalent spinal condition among elderly patients, causing symptoms such as lower back pain, leg pain, and muscle weakness [1].

As the LF covers a significant portion of the posterior-lateral aspect of the lumbar spinal canal, its hypertrophy is considered a key factor in the development of lumbar spinal stenosis. This hypertrophy can lead to compression of the dural sac and nerve roots, contributing significantly to symptoms like lower back pain and sciatica [1-7]. Researchers have focused on measuring LF thickness in the lumbar segments because hypertrophic facets and thickened ligament flava are commonly implicated in narrowing the spinal canal [7].

An increase in ligament size, posterior disc protrusion, or both can lead to compression of the nerve root. Ligament enlargement can be either generalized or unilateral and typically results from two factors: injury and subsequent scar tissue formation. Normally, ligament flava consist entirely of yellow elastic fibres and exhibit considerable elasticity. Following injury, whether minor or severe, there is often rupture of some of these elastic fibres, allowing for initial expansion. As the ligaments undergo repair, scar tissue forms and contributes further to their enlargement, ultimately leading to compression of the nerve roots [8].

Although LF thickness increases with age, hypertrophy of the LF can also occur due to disc degeneration or vertebral diseases, leading to narrowing of the spinal canal and stenosis. Therefore, efforts were made to compare lumbar spinal stenosis (LSS) with a controlled group.

Material and Methods:

50 controlled (normal) and 50 stenotic of lumbar spines patients who were regularly visiting Department of Radio-diagnosis, Patna Medical College and Hospital, Patna, Bihar, India, for one year, have been compared to study the thickness of ligamentum Flavum in both sexes.

Inclusive Methods: The Patients having lumbar spine stenosis (L3-S1) having symptoms of low back pain, radicular referred pain, and intermittent claudications were selected for study.

Method: 50 lumbar spine stenosis aged between 40 to 60 years, the ligamentum flavum thickness were studied by using Lumbar computerized Tomography (CT) images. The same age group controlled group of 50 healthy persons was also studied compared by CT images. The thicknesses of ligamentum Flavum (LF) in both groups were compared. All CT images in controlled and LSS groups were performed in the same position and techniques using the multi planar reformatting technique. Thickness of the section 1 to 3mm, 80 to 250mm. As the left and right LF thickness for each vertebral level (L3-S1) were measured at its mid-width distance in both groups. The duration of study was from January, 2024 to June 2024.

Exclusion Criteria: Patients having congenital anomalies of lumbar vertebrae, Tuberculosis and malignancy of lumbar region were excluded from the study.

Statistical Analysis: Mean values cross section Area in both groups, relative thickness of ligament flavum (LF) were compared in both sexes by SPSS Software.

Results:

Table-1 Study of mean values of cross section Area of Dural Sac in both group was at the level of L3-L4 in control group was 132.5 (±46) and LSS group was 65.2 (±23) at L4-L5 control groups was 133.3 (±44) and LSS groups had 48.3(±25). At the level of L5-S1, the control group was 136.2 (±46) and had 91.2 (±36).

Table 1: Mean cross section Area (CSA) of Dural SAC in both groups at different level

Mean Value	Control group (50)			LSS group (50)		
	L3-L4	L4-L5	L5-S1	L3-L4	L4-L5	L5-S1
CSA	132.5	133.3	136.2	65.2	48.3	91.2

Table-2 In the comparative study of thickness of ligament Flavum in both control and LSS group was, At the level of L4-L5 left in control group was 8 cm (±3) in LSS 11 cm (±4), 't' test value was 4.24 and P-value was highly significant (P<0.01). In right side mean value of controls was 9(±2) and LSS groups had 11.8 (±4) 't' test value was 4.42 and P-value was highly significant(P<0.1). At the level of L4-L5 right in controls mean value was 11(±3) and LSS group had 13 (±3) 't' test value was 3.33 and P-value was highly significant (P<0.01). In right side mean value was 11.5 (±3) and 13.8 (±3) in LSS group 't' test value was -3.83 and P value was highly significant (P<0.01). At the level of L5-S1 mean value of controls left was 10.2 (±2), 10.4 (±3) in LSS group, 't' test value was 0.39, P-value was (P<0.01). In right side mean value was 11.5 (±3), controls 11.2 in LSS group 't' test and P value P<0.05.

Table2: Comparative study of thickness of Ligamentum Flavum in both groups

Lumbar level		Control group (50)	LSS group	't' test value	P-value
L3-L4	Left	8(±3)	11(±4)	4.24	P<0.01
	Right	9(±2)	11.8(±4)	4.42	P<0.01
L4-L5	Left	11(±3)	13(±3)	3.33	P<0.01
	Right	11.5(±3)	13.8(±3)	3.83	P<0.01
L5-S1	Left	10.2(±2)	10.4(±3)	0.39	P<0.01
	Right	11.5(±3)	11.2(±3)	0.33	P<0.01

Table-3 Comparative study of relative thickness in both sexes of normal (controlled group)-25 male and 25 female normal (controlled) were studied. At the level of L3-L4 in males was 7.8 (±2) and in females 8.9 (±3) 't' test value was 0.55 and P-value was highly significant (P<0.01). In right side mean value males, 7.9(±2) and female 8.9(±3) 't' test value was 1.38 (P>0.01). At the level of L4-L5 of males in right side mean value 10.6 (±2) and in females 10.5 (±3) 't' test value 0.13 (P<0.01) In left side mean value of males was 10.2(±2) and females 10.8(±3)'t' test value 0.83 (P<0.01). At the levels L5-S1 mean value of male's right side 8.9 (±2) in females 9.8 (±3) 't' test value was 1.24 (P<0.01). In left side, mean value in males was 9.2 (±4) in females 9.9(±3) 't'test value was 0.7 (P<0.01).

Table3: Comparative study of relative thickness Ligamentum Flavum (LF) in normal (control) group of both sexes (25 male and 25 Female)

		MALE	FEMALE	't' test value	P-value
L3-L4	Left	7.8(±2)	8.2(±3)	0.55	P<0.01
	Right	7.9(±1/2)	8.9(±1/3)	1.38	P<0.01
L4-L5	Left	10.6(±2)	10.5(±3)	0.13	P<0.01
	Right	10.2(±2)	10.8(±3)	0.83	P<0.01
L5-S1	Left	8.9(±2)	9.8(±3)	1.24	P<0.01
	Right	9.2(±3)	9.9(±3)	0.7	P<0.01

Discussion

In the present study of thickness of LF in LSS and normal groups mean value of cross section area of Dural sac (CSA) mean value of control group at the level L3-L4 was132.5 (SD±46) and LSS group was 65.2(SD±23)at L4-L5 control groups was 133.3 (SD±44) and LSS groups had 48.3 (SD±25) At the level of L5-S1 the control group was 136.2 (SD±46) and had 91.2 (SD±36) (Table-1) But more thickness of LF was observed in LSS group than controlled groups in all three levels i.e. LF at L3-L4, L4-L5,L5-S1 due to hypertrophy of LF in LSS group (Table- 2).

Moreover in the normal group thickness LF was more in females then males (Table-3) these finding of present study more or less in agreement with previous studies [9-11] Thickness of LF was also observed in after the age forty in both genders [12]. Hence it can be hypothesized that, lumbar stenosis associated with LBP, radicular pain, sciatica was mainly observed elderly people rather than young adults. Significant changes in LF thickness were observed in L3-L4 and L4- L5. It could be due to hyper mobility of these two segments as compared to L5-S1 which is stabilized by the ilio-lumbar ligament and the large transverse processes of L5 vertebra.

In addition to this particular facet of S1 are more coronally oriented to act to decrease the shearing stress in that segment [13]. LF being a connective tissue that runs or connect from second cervical vertebra to first sacral vertebra [14]. Its functions effects the intrinsic stability of the vertebral spine, controls inter vertebral movement and maintains a smooth surface for Dural sac. It was also reported that vertebral segmental instability affects the pathophysiology of LF [15]. Hence degeneration of inter vertebra disc may cause hypertrophy or thickness of LF [16]. Hence it is difficult to designate hypertrophy or thickness of LF.

Conclusion

The present comparative study of thickness of LF in LSS with control groups will be quite useful to Radiologist, Neurosurgeon, Neuro physician to treat such patients efficiently. But this study demands further pathophysiological, nutritional, Kinesiological, genetic study, because this study suggests that the thickness of LF has no any correlation with height of body of vertebrae and exact pathogenesis of thickness of LF is still unclear.

References:

1. Beamer YB, Garner JT, Shelden CH. Hypertrophied ligamentum flavum. Arch Surg 1973;106:289–292.
2. Baily P, Casamajor L. Osteo-arthritis of the spine as a cause of compression of the spinal cord and its roots: with report of five cases. J Nerv Ment Dis 1911;38:588–609.
3. Park JB, Chang H, Lee JK. Quantitative analysis of transforming growth factor-beta1 in ligamentum flavum of lumbar spinal stenosis and disc herniation. Spine 2001;26:E492–495.
4. Towne EB, Reichert FL. Compression of the lumbosacral roots of the spinal cord by thickened ligament flava. Ann Surg 1931;94: 327–336.
5. Ulrich CG, Binet EF, Sanechi MG ,Kieffer SA.Quantitative assessment of the spinal canal by computed tomography.Radiology 1980 Jan; 134(1):137–143.
6. Okuda T, Baba I, Fujimoto Y, et al. The pathology of ligamentum flavum in degenerative lumbar spine. Spine 2004;29: 16 89–1697.
7. Yoshida M, Shima K, Taniguchi Y, et al. Hypertrophied ligamentum flavum in lumbar

spinal canal stenosis. Spine 1992;17:1353–1360.
8. Brown HA. Enlargement of the ligamentum flavum. J Bone Joint Surg Am 1938;20:325-38.
9. Towne E B, Reichert FL — Compression of lumbo sacral roots of the spinal cord by thickness ligamentum flavum. Ann. Surg. 19 31,94, 327-36
10. Okuda T, Baba I- Pathology of ligamentum flavum in degenerative lumbar spine. Spine. 2004,29, 1689-97
11. Schonstroom NS, Hanson T- pressure changes following construction of the caudal equine an experimental study in situ. Spine .1988,13,385-8
12. Sairyok Biyani A, Goel V- Patho-mechnism of ligamenutum flavum hypertrophy a muti disciplinary investigation based on clinical, biomechanical histological and biological assessment. Spine, 2005,30,2649- 56
13. Masharawi Y, Rothschild B- Fact orientation in the thoraco lumbar spine three dimensional anatomic and bio-mechanical analysis. Spine 2004,16,1755-63
14. Abbas J, Hamoud. K- Ligamentum flavum thickness in normal and stenotic lumbar spines. Spine- 2010,35(12)1225-30
15. Bark JB, Lee J K- Hypertrophy of ligmentum flavum in lumbar spinal stenosis associated with increased protinase inhibitor concentration. Bone joint surg. 2005,87 (12) 2750-7
16. Sakamaki T, Sairyoik — Measurement of ligmentum Flavum thickening at lumbar spine, using MRI, Arch orthop. Trauma surg. 2009, 129(10) 1415-9.