Assessment of ligamentum flavum thickness correlation with demographic variables and disc degeneration in Erbil governorate population sample

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Abstract

Background and objectives: This study aimed to investigate the correlation between the ligamentum flavum thickness and age, sex, body mass index and type of disc degeneration.

Method: 126 consecutive patients were examined prospectively. The sample included all the patients who had an MRI examination after they presented to Rizgary teaching hospital complaining of lower back and/or leg pain. The LF thickness was measured by using lumbo-sacral spine MRI.

Results: The mean thickness of LF was more at L4-L5 (right: 0.27 mm, left 0.25 mm), L5-S1 (right: 0.25 mm, left 0.25 mm) levels, and was thicker on the right side. LF was thicker in females than males with a statistically significant measurement at L2-L3, L3-L4 and L4-L5 levels. The mean thickness of LF was more at older age group than the younger age groups, and the results were statistically different at left side of L2-L3 and right side of L4-L5 level. Thickness of LF was more among those with higher BMI for all levels except for L5-S1. In most cases, LF was thicker in patients with advanced disc degeneration.

Conclusion: Thickening of the LF is associated to some extent with sex, age, BMI and disc degeneration. Thickening of the LF is potentially due to its buckling into the spinal canal secondary to disc degeneration more than to LF hypertrophy. Further research is needed to confirm these associations.

Keywords: Ligamentum Flavum, Disc Degeneration, MRI, Thickness.

Introduction

The ligamentum flavum (LF) is also called the yellow ligament, because the normal LF is yellow due to its greater content of elastic fiber than collagen fiber. [1] The ligamentum flavum covers most of the posterolateral part of the lumbar spinal canal extending from the second cervical vertebra to the sacral one. [2,3] The LF connects two adjacent laminae and lines an important part of the osseous and soft tissue sections of the posterior epidural region. [4,5] Hypertrophy of the LF is considered an important causative factor in the development of lumber spinal stenosis, compression of the dural sac and roots, and significantly contributes to lower back pain and sciatica [2,6] even in the absence of a bulging annulus fibrosus, herniated nucleus pulposus, or osseous spurs. [7,8] The LF is an important anatomical structure, which might cause lower back or leg pain. Therefore, the thickness of the LF should be measured and evaluated carefully in the case of spinal stenosis[7]. This study aims to investigate the correlation between the ligamentum flavum thickness and age, sex, body mass index (BMI) and type of disc degeneration.

Method

126 consecutive patients were examined prospectively. The sample included all the patients who had an MRI examination after they were referred by a specialist Orthope-dician to Rizgary teaching hospital complaining of lower back and/or leg pain

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from September 2011 to January 2012. 2011 to January 2012. Patients with previous lumbar spinal surgery, evidence of lumbar or sacral tumors at MRI, diffuse bone metastasis, serious congenital anomalies, severe scoliosis, diskitis, osteomyelitis, serious lumbar vertebral fracture, spondylolysis, or spondylolisthesis were excluded from the study. The MR images were obtained with a 1.5-T unit (MAGNETOM Avanto, Tim System, Bavaria, Germany). The imaging studies include sagittal T1-weighted images (TR/TE, 590/11and slice thickness , 4 mm), sagittal T2-weighted images (TR/TE, 3500/92; and slice thickness, 4 mm), axial T2-weighted images (TR/TE, 4000/100; and slice thickness, 4 mm), and axial T1-weighted images (TR/TE, 530/17; and slice thickness, 4 mm) for all MRI examinations. The lumbar MR images were reviewed by two experienced radiologist (MD) on a digital workstation. The measured thicknesses of the LF, intervertebral disc degeneration were recorded for all subjects. The thickness of LFs were measured at L2–L3, L3–L4, L4–L5, and L5–S1 level in 126 patients on axial T1-weighed MR images at the facet joint level. All the LF thicknesses were measured by using an electronic ruler with a resolution of 0.1 mm. Thickness at the middle portion of LF was measured. The measurements were repeated twice at different times, and mean values were recorded. In cases of asymmetrical LF thickness, the thicker value was used. The intervertebral discs from L2–L3 to L5–S1 were assessed on the T2-weighted midsagittal images. The degree of degeneration was classified into five grades by using the classification of Pfirrmann *et al*[9], which uses both signal intensity and disc height categories. The LF thickness of the grades I to III and grades IV to V degeneration groups were compared statistically using student t-test with P-value of ≤0.05 indicating a statistically significance difference.

Results

One hundred twenty six patients participated in the study. Their mean age±SD was 43.8±15.1 years. Demographic characteristics of the participants are shown in Table 1.

Table 1: Demographic characteristics of the participants.

Characteristic	No.	%
Age group (years)		
13-19	6	4.8
20-29	15	11.9
30-39	42	33.3
40-49	21	16.7
50-59	18	14.3
60-69	15	11.9
70-79	9	7.1
Gender		
Male	45	35.7
Female	81	64.3
BMI		
<25	24	19.0
25+	102	81.0

Table 2 shows type of disc degeneration at different levels. The degeneration was more at more advanced stages at L4-L5 and L5-S1 levels.

Table 2: Type of degeneration at different levels

Type of degeneration	No	%
L2-L3		
I-III	120	95.2
IV-V	6	4.8
L3-L4		
I-III	108	85.7
IV-V	18	14.3
L4-L5		
I-III	93	73.8
IV-V	33	26.2
L5-S1		
I-III	93	73.8
IV-V	33	26.2

The mean thickness of LF was more in L4-L5 (right: 0.27 mm, left 0.25 mm) and L5-S1 (right: 0.25 mm, left 0.25 mm) levels and was also generally more on the right side than the left side as shown in Table 3.

Table 3: Mean thickness of LF at different levels and in both sides.

Lumber level		LF thickness mm+SD	
		Mean	SD
L2-L3	Right	0.23	0.33
	Left	0.18	0.08
L3-L4	Right	0.24	0.09
	Left	0.21	0.08
L4-L5	Right	0.27	0.11
	Left	0.25	0.11
L5-S1	Right	0.25	0.12
	Left	0.25	0.11

Thickness of LF was more in females than males. The results were statistically significant at left side of L2-L3 and L3-L4 levels and at both right and left sides of L4-L5 level as shown in Table 4.

Table 4: Association of thickness of LF with gender of the patients.

Lumber level		LF thickness mm+SD				
		Male		Female		
		Mean	SD	Mean	SD	P value
L2-L3	Right	0.16	0.05	0.27	0.40	0.072
	Left	0.14	0.05	0.20	0.08	0.001
L3-L4	Right	0.22	0.07	0.25	0.10	0.054
	Left	0.18	0.05	0.23	0.09	0.004
L4-L5	Right	0.22	0.09	0.30	0.11	0.001
	Left	0.20	0.06	0.27	0.12	0.001
L5-S1	Right	0.25	0.12	0.26	0.11	0.669
	Left	0.23	0.11	0.25	0.12	0.353

The mean thickness of LF was more at older age than the younger age groups. This difference was statistically different at left side of L2-L3 level and right side of L4-L5 level (Table 5).

Table 5: Association of LF thickness with the age groups.

Lumber level		LF thickness mm+SD						
		<45 years		46-60 years		>60 years		
		Mean	SD	Mean	SD	Mean	SD	*P value*
L2-L3	Right	0.25	0.44	0.20	0.07	0.19	0.02	*0.617*
	Left	0.16	0.08	0.20	0.08	0.22	0.02	*0.003*
L3-L4	Right	0.23	0.08	0.26	0.11	0.23	0.10	*0.126*
	Left	0.21	0.08	0.21	0.09	0.23	0.06	*0.402*
L4-L5	Right	0.25	0.11	0.30	0.10	0.29	0.09	*0.029*
	Left	0.23	0.11	0.26	0.10	0.28	0.12	*0.094*
L5-S1	Right	0.25	0.11	0.23	0.11	0.30	0.14	*0.091*
	Left	0.23	0.11	0.25	0.13	0.29	0.09	*0.218*

Thickness of LF was more among those with higher BMI for all levels except for level L5-S1. However this difference was only statistically significant for the left side of L2-L3 (Table 6).

Table 6: Association of LF thickness and BMI of participants.

Lumber level		LF thickness mm+SD				P value
		BMI<25		BMI≥25		
		Mean	SD	Mean	SD	
L2-L3	Right	0.18	0.05	0.24	0.36	0.470
	Left	0.15	0.07	0.19	0.08	0.018
L3-L4	Right	0.24	0.05	0.24	0.10	0.915
	Left	0.20	0.05	0.21	0.08	0.269
L4-L5	Right	0.24	0.08	0.28	0.11	0.135
	Left	0.23	0.04	0.25	0.12	0.553
L5-S1	Right	0.27	0.10	0.25	0.12	0.439
	Left	0.25	0.10	0.24	0.12	0.756

Thickness of LF was more among cases with advanced stages of degeneration. However, this difference was only statistically significant at left side of level L2-L3 as shown in Table 7.

Table 7. Association of LF thickness and stage of disc degeneration.

Lumber level		LF thickness mm+SD				P value
		Type I-III		Type IV-V		
		Mean	SD	Mean	SD	
L2-L3	Right	0.18	0.07	0.18	0.04	0.715
	Left	0.16	0.07	0.21	0.08	0.001
L3-L4	Right	0.26	0.11	0.24	0.07	0.386
	Left	0.21	0.10	0.22	0.06	0.939
L4-L5	Right	0.27	0.12	0.31	0.10	0.063
	Left	0.27	0.15	0.26	0.11	0.721
L5-S1	Right	0.23	0.04	0.25	0.12	0.403
	Left	0.21	0.09	0.23	0.10	0.321

Discussion

The LF covers a considerable part of the posterior and lateral walls of the spinal canal. [10] Thickening of the LF can reduce the diameter of the spinal canal, compressing the dural sac and nerve roots, and contributes to low back pain and sciatica even in the absence of a bulging annulus fibrosus, herniated nucleus pulposus, or osseous spurs. [7] Some differences were found among the LF thicknesses at each level, this finding is in agreement with previous studies. [7,11,12] The thickest LF measurement was at L4–L5 and L5-S1. LF was thicker in females than males, this finding disagree with previous studies. [7,13] However, this could be attributed to the nature of the heavy work done by the women in Iraq. In our study we found that LF thickness increases proportionately with age, this observation is supported by previous studies which suggest that LF thickness is an age-dependent phenomenon. [10,12,13] An association between disc degeneration and obesity had been reported; a high BMI associates significantly with disc degeneration. [14] It was found that the LF thickness at most levels were greater in the subjects with BMI of 25 kg/m2. High BMI positively associated with LF thickness at the L2–L3 disc level. This observation agrees with another study. [11] The pathogenesis of thickening of the LF is not well understood. Some studies have asserted that age-related fibrosis or decrease in the elastin-to-collagen ratio of the LF, along with hypertrophy of the LF, is associated with lumbar spinal stenosis, while others argued that the LF bulges inside the spinal canal and compresses nerve tissues. [1,10] The "thickening" is the buckling of the LF into the spinal canal after disc collapse.[11] To evaluate this theory, the relationship between the thickness of the LF and intervertebral disc degeneration, disc height at L2–L3, L3–L4, L4–L5, and L5 –S1 were examined; it was found that the LF was generally thicker in patients with grades IV to V degeneration than in those with grades I to III. This result was only statistically significant at L2-L3 level; this finding could be attributed to the small sample size of the study, as previous studies had shown significant difference at all levels with only one study contradicting this correlation.[10] One can only verify this relationship through histopathological examination. Hence, further studies are required to confirm this association. In conclusion, thickening of the LF is associated to some extent with sex, age, BMI and disc degeneration. The thickening of the LF is potentially due to its buckling into the spinal canal secondary to disc degeneration, more than to LF hypertrophy alone. Further research is needed to confirm these associations.

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