

Research Article

The Effect of the Paraspinal Muscles on Lumbar Disc Herniation

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Abstract

Objectives: Lumbar disc degeneration is diagnosed with radiological signs in the paraspinal muscles (PSM) seen on lumbar magnetic resonance imaging. It is associated with body weight, height, and a high body mass index (BMI). The role of the PSM has not been examined in the literature. The aim of this study was to analyze hernia grading, bilateral PSM length, and BMI.

Methods: The grading of herniation size and the anteroposterior (AP) length of the bilateral PSM and their distance to the skin was assessed at lumbar intervertebral levels in 70 patients with low back pain. Data collected were the bilateral AP lengths of the psoas and PS erector muscle group, Modic type endplate degeneration, and hernia grade at each intervertebral level from L1 to S1. Patients' age, sex, and BMI were also recorded.

Results: The hernia grades 0-1 were common at the L1-L2, L2-L3, and L3-L4 levels with statistical significance, and hernia grades 2-3 were common at the L4-L5 and L5-S1 levels. The mean age of the patients with a normal BMI was lower than that of the patients who were overweight or obese. The mean age was associated with hernia grade only at the L2-L3 and L3-L4 levels, and it was also related to the right side AP length of the PSM at the L2-L3 and bilateral psoas to skin distance at L3-L4. BMI was not associated with any AP length of bilateral PSM except at the L5-S1 level. There was a correlation between hernia grade 0 and AP length of the right PSM at the L2-L3 level and the left PSM at the L4-L5 level.

Conclusion: PSM atrophy was not related to the severity of hernia or pain, and control of BMI may be effective for hernia. Further studies are required to confirm a possible relationship between the PSM and lumbar disc hernia.

Keywords: Body mass index, hernia grade, magnetic resonance imaging, paraspinal muscle length

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The lumbar disc degeneration is very common problem among patients. Patients with this problem are diagnosed usually with the symptom of low back pain (LBP) which is followed by lumbar MRI (magnetic resonance imaging).^[1,2] During the evaluation of a lumbar MRI the changes in the paraspinal muscles (PSM) are usually overlooked in clinical routine. The diagnosis of disc herniation has been associated with many factors in the literature such as body weight, height and high body mass index (BMI).^[3-6] Lumbar PSM is composed of iliocostalis, longissimus and spinalis called PS erector muscle group and multifidus muscle. The PSM support the spine, maintain posture, and assist in trunk movements. Their function of postural con-

trol and lumbar movement perception is very important in stabilization of disc herniation. The role of PSM in hernia formation have not been questioned directly.^[7-10] However, there have been many studies relating the paraspinal muscles atrophy, asymmetry, or fatty infiltration to the LBP problems.^[7-9, 11-17] Here, we presented a multiparameter involved complex study which analysed the hernia grading, bilateral PSM muscle lengths, and BMI.

Materials and Methods

Seventy patients 40 (58%) females and 30 (42%) males, age range 30-50; mean age 47.2±13.5 years were studied. The lumbar MRI of LBP patients from the records of Radiology

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Table 1. Patient characteristics

		Total		L1-L2		L2-L3		L3-L4		L4-L5		L5-S1		p
		n	%	n	%	n	%	n	%	n	%	n	%	
Hernia type	0	147	43.9	54	80.6	37	55.2	22	32.8	11	16.4	23	34.3	<0.001
	1	123	36.7	8	11.9	23	34.3	36	53.7	35	52.2	21	31.3	
	2	59	17.6	5	7.5	6	9.0	9	13.4	18	26.9	21	31.3	
	3	6	1.8	0	0.0	1	1.5	0	0.0	3	4.5	2	3.0	
	Total	335	100	67	100	67	100	67	100	67	100	67	100	

Department of Kartal Lutfi Kirdar Training and Research Hospital were evaluated. Patients who had systemic diseases, tumour, infection, spinal fracture and surgery were excluded from the study. Data was composed of the bilateral AP lengths of psoas and PS erector muscle group type, Modic type end plate degenerations, and hernia grades at each intervertebral level from L1 to S1 (Figure 1–4). Our patients' age, sex, and BMI were also recorded.

Imaging Protocol

MRI of the lumbar spine was performed with a 1.5-T imager (Symphony; Siemens Medical Solutions, Erlangen, Germany) and a dedicated receive-only spine coil. Images were obtained in the sagittal and axial planes. The images were obtained at each intervertebral disc level from L1 to S1. The imaging protocol included sagittal T1-weighted SE (700/12) and T2-weighted fast SE (5,000/130) sequences with the following parameters: matrix, 512×225; field of view, 300 mm; section thickness, 4 mm; intersection gap, 0.8 mm; number of signals acquired, four; echo train length, eight. Transverse T2-weighted fast SE (4,000/122) images also were acquired with the following parameters: matrix, 210 × 256; field of view, 150 mm; intersection gap, 0.8 mm; number of signals acquired, two; echo train length, eight.

Statistical Analyses

For statistical analysis SPSS 15.0 program for the windows operating system was used. Descriptive statistics for the categorical variables were given including numbers and the percentage together with the mean value for the numeric variables and the standard deviation. If numeric variables were normally distributed, the comparisons between the groups were performed with Student's T-Test, the comparisons between two and more groups were done with one-way ANOVA test. If numeric variables were not normally distributed, two group comparisons were analyzed with Mann-Whitney U test and comparisons of more than two groups were done with Kruskal-Wallis H test. For the sub-group analysis; for more than two groups in parametric test; Tukey, in non-parametric test; Mann-Whitney U were performed. Bonferroni was used for editing. Ratios

between the groups of categorical variables were tested by chi square analysis. The Monte Carlo simulation was performed if the requirements are not present. The relationship between the numerical variables were evaluated by Spearman correlation test. Statistical significance alpha level was considered as $p < 0.05$.

Results

Mean age of the patients was 47.2 ± 13.5 (range, 30–50) and their mean BMI was 26.2 ± 2.7 (range, 20–31.6). In terms of BMI, 18 patients were normal, 41 patients were overweight and 8 patients were obese. According to Modic types, 10 patients did not have degeneration (0), 25 patients had type 1 and 32 patients had type 2. The hernia grade 0–1 was common at L1-L2, L2-L3, L3-L4 levels and hernia grade 2–3 rate was common at L4-L5, L5-S1 levels and statistically significant difference was determined between them ($p < 0.001$) (Table 1).

Significant statistical relationship was determined between the BMI and average age of the patients ($p = 0.002$). It was determined that the average age of the patients with normal BMI was lower than the patients who are overweight and obese ($p = 0.014$, $p = 0.002$).

The mean age was found effective only at L2-L3, L3-L4 levels with the grade of hernia ($p < 0.001$, $p = 0.036$). Moreover, the mean age of patients was related with the right side AP lengths of paraspinal muscles at L2-L3 and with the both side psoas to skin distance at L3-L4 statistically. There was significant relation between age and right psoas to skin distance at L3-L4 level.

Last of all only the bilateral paravertebral muscle to skin distance at L5-S1 level showed statistically significant relationship with the BMI (Table 2) ($p < 0.001$). Bilateral AP lengths of the paravertebral muscles didn't show any statistical correlation with the hernia grades 1 and 2. However we found correlation between hernia grade 0 and AP length of the right paraspinal muscle at L2-L3 level and left paraspinal muscle to skin and psoas muscle to skin distances at L4-L5 level (Table 3).

The patients' gender did not present a statistically signifi-

Table 2. Relationship between age, BMI, and hernia location

		Age		BMI	
		rho	p	rho	P
L1-L2	S-C Length	0.096	0.442	0.369	0.002
	PSOAS Right	-0.199	0.107	-0.141	0.255
	PSOAS Left	-0.079	0.526	-0.032	0.797
	PSOAS-Skin Right	0.188	0.127	0.326	0.007
	PSOAS -Skin Left	0.196	0.112	0.326	0.007
	PRS Muscle Right	0.174	0.158	0.208	0.092
	PRS Muscle Left	0.183	0.139	0.197	0.110
	PRS -Skin Right	0.151	0.223	0.474	<0.001
	PRS-Skin Left	0.140	0.259	0.427	<0.001
L2-L3	S-C Length	0.118	0.341	0.356	0.003
	PSOAS Right	-0.149	0.229	-0.207	0.093
	PSOAS Left	-0.060	0.628	-0.111	0.370
	PSOAS-Skin Right	0.187	0.129	0.373	0.002
	PSOAS -Skin Left	0.233	0.057	0.394	0.001
	PRS Muscle Right	0.228	0.063	0.230	0.061
	PRS Muscle Left	0.275	0.024	0.260	0.034
	PRS -Skin Right	0.165	0.182	0.441	<0.001
	PRS-Skin Left	0.211	0.087	0.460	<0.001
L3-L4	S-C Length	0.059	0.635	0.308	0.011
	PSOAS Right	-0.107	0.387	-0.055	0.660
	PSOAS Left	-0.220	0.074	-0.137	0.270
	PSOAS-Skin Right	0.251	0.041	0.404	0.001
	PSOAS -Skin Left	0.172	0.164	0.389	0.001
	PRS Muscle Right	0.205	0.096	0.166	0.180
	PRS Muscle Left	0.249	0.042	0.235	0.055
	PRS -Skin Right	0.027	0.831	0.438	<0.001
	PRS-Skin Left	0.055	0.659	0.448	<0.001
L4-L5	S-C Length	-0.077	0.538	0.267	0.029
	PSOAS Right	-0.195	0.113	-0.108	0.383
	PSOAS Left	-0.120	0.334	-0.027	0.831
	PSOAS-Skin Right	0.183	0.138	0.413	0.001
	PSOAS -Skin Left	0.189	0.126	0.378	0.002
	PRS Muscle Right	-0.148	0.233	0.069	0.577
	PRS Muscle Left	-0.046	0.714	0.123	0.321
	PRS -Skin Right	-0.061	0.626	0.332	0.006
	PRS-Skin Left	-0.005	0.968	0.324	0.008
L5-S1	S-C Length	-0.174	0.158	0.178	0.150
	PSOAS Right	0.066	0.598	0.010	0.936
	PSOAS Left	0.029	0.815	-0.023	0.854
	PSOAS-Skin Right	0.101	0.414	0.133	0.283
	PSOAS -Skin Left	0.069	0.580	0.086	0.489
	PRS Muscle Right	0.001	0.996	0.196	0.113
	PRS Muscle Left	-0.006	0.964	0.199	0.106
	PRS -Skin Right	-0.094	0.448	0.302	0.013
	PRS-Skin Left	-0.099	0.427	0.264	0.031

BMI: Body mass index.

cant difference. No statistically significant relationship was determined between the Modic types and BMI ($p=0.179$,

Table 3. Relationship between pruritis and hernia location

Level		Pruritis				p	
		Yes		No			
		n	%	n	%		
L1-L2	Hernia grade	0	30	76.9	24	85.7	0.152
		1	4	10.3	4	14.3	
		2	5	12.8	0	0.0	
L2-L3	Hernia grade	0	20	51.3	17	60.7	0.581
		1	15	38.5	8	28.6	
		2	4	10.3	2	7.1	
L3-L4	Hernia grade	0	14	35.9	8	28.6	0.070
		1	23	59.0	13	46.4	
		2	2	5.1	7	25.0	
L4-L5	Hernia grade	0	8	20.5	3	10.7	0.169
		1	21	53.8	14	50.0	
		2	10	25.6	8	28.6	
L5-S1	Hernia grade	0	12	30.8	11	39.3	0.339
		1	13	33.3	8	28.6	
		2	14	35.9	7	25.0	
		3	0	0.0	2	7.1	

$p=0.879$). Neither between the hernia grade and BMI ($p=0.063$, $p=0.054$).

Discussion

In contrast to other skeletal muscles the PSM provides extension of spine by agonist force, otherwise coupling with antagonist muscle provides one side flexion. Therefore, we measured bilaterally. We didn't consider the duration of LBP symptoms basing on the literature that observed the PSM asymmetry was not correlated with duration of symptoms.^[18]

There have been a few studies searching the morphologic relation of paraspinal muscles with the lumbar disc herniation such as Mattila et al.,^[19] measured type I and II muscle fibers of multifidus muscle both in post operative lumbar disc herniated patients and control group which was assessed by cadavers. The resulted type II were smaller than the type I muscle fibers and type I fibers had a different appearance. However, their results didn't support a certain relation with herniation by presenting themselves in both groups. Only the changes were significantly more common in the patients than in the controls. Another study supporting the different morphology in the pathological side was done by Ploumis et al.,^[18] with 40 monosegmental degenerative patients with LBP showing significant difference between the CSA (cross section area) of healthy and pathologic sides. There have been also studies searching

a relation between pain and muscle atrophy.^[20] However which came first the chicken or the egg? Did the hernia cause pain and finally atrophy or vice versa? The literature defined the presence of difference from the healthy subjects. Therefore without a control group choosing a random LBP population including all grades of hernia provided us an objective population. Different from the literature, we observed at certain intervertebral (IV) disc levels such that L2-3 and L4-5 the AP lengths of PSM could be a preventive measure for herniation by finding significant association of hernia type 0 with AP lengths of PSM. Supporting our finding from the literature Dannels et al.^[15] with 23 healthy volunteers and 32 LBP patients study mentioned the small size of multifidus at the lower end-plate of L4 vertebra particularly. Fortin et al.^[12] highlighted the L4-5 level in another study including 33 patients diagnosed with posterolateral disc herniation at L4-L5 and found the erector spinae FCSA (functional cross sectional area) and the ratio of FCSA/CSA was smaller on the side of the herniation at L4-5. In our study we would like to take attention to the L2-3 level. By finding the significance of PSM length at this level we add a new discussion, "Is there a mirror symmetry around L3-4 supporting lumbar spine?" Moreover we would like to underline side to side difference between these levels.

The patients' gender and hernia grades also didn't present statistical difference. Our study was the first one questioning the relation between the gender and hernia grades. We couldn't find a significant relation between the BMI and hernia grades as well.

Different from Pye et al.^[21] and Kalichman et al.^[4] who found the relationship between the BMI and hernia but similar to Fanuele et al. who observed the disk hernia or muscle sprain were not related with BMI.^[22] However literature includes more other studies defending a relation between the BMI and hernia.^[3, 5, 6]

The patients' age was another parameter to be questioned as a causative factor for hernia or vertebral deformities. In the literature, the vertebral osteophytes were seen more in elderly population^[23] or the increased age associated with the lumbar spondylosis, and disc space narrowing.^[23, 24] Our study found young patients had significantly lower BMI but having low BMI wasn't associated with any Modic type degenerative change. So it was different from the literature questioning age and vertebral deformities.^[23] However we observed the patients' mean age was related with hernia grades only at intervertebral discs between L2-4. Moreover the mean age was playing critical role on the right PML at L2-3 and on the psoas to skin distance at L3-4.

In summary with our multiparameter coded complex study; we had interesting results after statistical analyses

such that non occurrence of lumbar hernia was more related with muscle length than the occurrence. According to us the much debated issue of PSM atrophy was not related with severity of hernia or the pain itself. Surprising finding of the mirror symmetric forces of around L3-L4 was consolidated by another finding of the sufficient psoas to skin distance requirement of L3-L4 as the central point. The BMI was effective maybe for hernia occurrence but not playing a role in the formation of different grades. The age wasn't found to be involved both the PML and hernia grades below L3-4. Even though the population size was small, it was the first study with its multiparameter involvement. The next step could be planning new studies focused on the PML at L2-3 and L4-5 on physiotherapy for decreasing hernia grade. Therefore our interesting results are valuable to compare with similar studies in the future.

Disclosures

Ethics Committee Approval: The study was approved by the Local Ethics Committee.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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