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# Comparison of Pathologic Findings of Lumbosacral MRI between Low Back Pain Patients and the Controls

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## ABSTRACT

*Background: Low back pain is a highly common condition in general population. Different mechanisms and causes are considered to be responsible for development of this condition. There is a controversy regarding the usefulness of MRI in low back pain. We aimed in this study to compare MRI findings between healthy subjects and low back pain patients.*
*Methods: In this case-control study at Shohadaye-e-Tajrish hospital in 2015, we compared lumbosacral MRI findings of 284 patients with clinical history of low back pain and/or radiculopathy with 59 age- and sex- matched subjects without clinical history of LBP or radiculopathy. The controls were randomly selected from the staff of the hospital. MRI scans were thoroughly reviewed by the experts and the related data were recorded and analyzed.*
*Results: Our data show that there is a strong association between low back pain and fat infiltration in that muscle as in the case group, there was a 39.2% rate of fat infiltration while in the control group, this rate was only 8.5% (p-value=0.000). Our data reveal that various types of degeneration and stenosis in lumbar spine associate with low back pain. Although these symptoms and findings are also found in healthy subjects but the difference of rates between low back pain and control groups, is statistically significant.*
*Conclusion: Our findings confirm the claim that LBP is significantly associated with degenerative changes observed in lumbosacral MRI as well as fat infiltration in multifidus muscle.*

**Key words:** Low back pain, MRI scans, Patients, Muscle

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## INTRODUCTION

Low back pain is a so common medical condition that is listed second among the reasons for medical care seeking. In United States, Low back pain's medical care cost reaches beyond 8 billion dollars yearly [1]. This high figure indicates a huge burden on the socioeconomic system of all the countries around the world. Globally, point prevalence of low back pain is 12%-13% [2]. In Iran, the point prevalence of low back pain in patients over 15 years of age in urban areas was 15.4% while it was 23.4% in rural areas [3]. Lifetime prevalence of low back pain is an extremely high rate which is around 84% [2].

It seems that low back pain is associated with atrophy of paraspinal muscles. Lumbar multifidus muscles are considered as important stabilizers of lumbar spine and so the role of multifidus muscle in development of low back pain has been studied in recent years [4]. It has been known that after a period of low back pain, atrophy with fatty replacement occurs in this muscle and "fatty atrophy" is visualized on MRI scans of the lumbar spine [5]. The association of this lesion on MRI and Low back pain is strongly suggested in several studies [4]. There has been a wide range of spinal pathologies which have been reported to be accompanying low back pain in adults and yet, there is contraversy going on regarding the definite association of these pathologies with low back pain.

A recent systematic review with meta-analysis in 2015 on 280 unique studies on MRI findings of low back patients, has reported that disc bulge, spondylolysis, disc extrusion, Modic 1 changes, disc protrusion and disc degeneration have been higher in patients with symptomatic low back pain while the association of any Modic change, central canal stenosis, high-intensity zone, annular fissures and spondylolisthesis with low back pain was not proved [6].

On the other hand, there are some studies describing pathologies in spinal MRI of healthy subjects without symptoms of low back pain. These categories of studies claim that caution must be taken for interpretation of MRI findings in low back pain condition. Due to high prevalence of these findings in asymptomatic subjects, definite conclusion of association of these pathologies with low back pain might be misleading [7,8].

Still there is no data available regarding the prevalence of muscular atrophy and other pathologies in lumbosacral MRI of Iranian healthy subjects. Due to high prevalence of low back pain in Iran, we aimed to compare the abnormal findings on lumbosacral MRI between healthy subjects and symptomatic patients to identify probable associations of underlying lesions on imaging and presence of low back pain.

## MATERIALS AND METHOD

### Sample recruitment

In this case-control study at Shohaday-E-Tajrish hospital in Tehran, we evaluated 284 symptomatic low back pain patients who were indicated for performing MRI and 59 healthy controls. Control subjects were chosen from hospital staff that did not have any episode of low back pain more than 1-week long in the last two years. Controls were age- and sex-matched with case group. Informed consent was taken from all participants. Participants with contraindication for MRI were excluded from the study which included cardiac pacemaker, presence of any metal device in the body, clustrophobia, pregnancy and unwillingness for continuation of the study.

### Questionnaire

A questionnaire was filled for every participant by a trained researcher. The questions included sex, age, height, weight and presence of low back pain.

### Imaging and interpretation

After filling the questionnaires, lumbosacral MRI was performed for participants. The imaging protocol included Sagittal T1 spin echo (400/10 TR/TE), 320*240 matrix, 340 FOV; Axial T2 fast spin echo (2500/100 TR/TE), 320*240 matrix, 220 FOV and Sagittal T2 fast spin echo (2500/99 TR/TE), 320*240 matrix, 340 FOV with 4 mm section thickness. Low field 1.5 T MRI and body spine surface coil was used.

After imaging, all scans were reported by an expert radiologist who was blinded to the current and previous history of the patient. Degenerative changes in vertebral body, degenerative changes in facet joints, central canal stenosis, neural foraminal stenosis, compression of nerve roots were recorded. Each one was measured in separate lumbar vertebral levels according to condition's severity (mild, moderate and severe). Disc herniation was evaluated as bulge, protrusion or extrusion at separate lumbar vertebral levels. Fat infiltration's presence in multifidus muscle at L5-S1 level in both sides was assessed. Fat presence in more than 10 percent of muscle cross sectional area was considered as fat infiltration. Fat infiltration's assessment was performed on T1-weighted images in axial sequence at each level. Data analysis was performed with SPSS v.22 and significance level was considered as p-value <0.05.

## RESULTS

### Control group

59 controls were evaluated in our study. 32 subjects were female (54%). The mean age of controls was 39 ± 9.93 years. Weight and height of this group were 68.36 ± 10.80 kg and 164.75 ± 7.27 cm, respectively. The mean of calculated BMI reached 25.34 ± 4.33 kg/m$^2$. Table 1 shows the frequency of MRI findings in the control group.

**Table 1: MRI findings in healthy controls**

| **Degenerative changes in lumbar vertebrae (8 subjects, 14%)** | | | | |
|---|---|---|---|---|
| | **None** | **Mild** | **Moderate** | **Severe** |
| L1-L2 | 53 | 4 | 0 | 0 |
| L2-L3 | 53 | 2 | 1 | 1 |
| L3-L4 | 54 | 1 | 2 | 0 |
| L4-L5 | 54 | 2 | 2 | 0 |
| L5-S1 | 53 | 4 | 1 | 0 |
| **Facet degeneration in lumbar vertebrae (20 subjects, 34%)** | | | | |
| L1-L2 (Left) | 51 | 5 | 0 | 0 |
| L1-L2 (Right) | 51 | 5 | 0 | 0 |
| L2-L3 (Left) | 47 | 7 | 2 | 1 |
| L2-L3 (Right) | 47 | 7 | 2 | 1 |
| L3-L4 (Left) | 45 | 12 | 0 | 0 |
| L3-L4 (Right) | 44 | 12 | 1 | 0 |
| L4-L5 (Left) | 42 | 13 | 2 | 0 |
| L4-L5 (Right) | 31 | 14 | 2 | 0 |
| L5-S1 (Left) | 48 | 7 | 2 | 0 |
| L5-S1 (Right) | 47 | 8 | 2 | 0 |
| **Degenerative changes in lumbar disks (32 subjects, 54%)** | | | | |
| L1-L2 | 48 | 6 | 0 | 1 |
| L2-L3 | 46 | 6 | 2 | 2 |
| L3-L4 | 41 | 10 | 3 | 1 |
| L4-L5 | 36 | 14 | 4 | 1 |
| L5-S1 | 40 | 9 | 5 | 2 |

| | | | | |
|---|---|---|---|---|
| **Canal stenosis in lumbar spine (9 subjects, 15%)** | | | | |
| L1-L2 | 54 | 4 | 0 | 0 |
| L2-L3 | 53 | 3 | 0 | 2 |
| L3-L4 | 51 | 3 | 2 | 2 |
| L4-L5 | 50 | 4 | 4 | 1 |
| L5-S1 | 51 | 5 | 1 | 1 |
| **Neural foraminal stenosis in lumbar spine (25 subjects, 42%)** | | | | |
| L1-L2 (Left) | 53 | 3 | 0 | 0 |
| L1-L2 (Right) | 53 | 3 | 0 | 0 |
| L2-L3 (Left) | 51 | 3 | 1 | 1 |
| L2-L3 (Right) | 51 | 3 | 1 | 1 |
| L3-L4 (Left) | 46 | 9 | 0 | 1 |
| L3-L4 (Right) | 45 | 10 | 0 | 1 |
| L4-L5 (Left) | 35 | 19 | 3 | 1 |
| L4-L5 (Right) | 36 | 18 | 3 | 1 |
| L5-S1 (Left) | 44 | 13 | 1 | 0 |
| L5-S1 (Right) | 44 | 13 | 1 | 0 |

Scoliosis was present in only 3 controls; all of them were to the right. Sacralization was seen in 2 patients; both of them were in both sides. Spondylolysis was not seen in any of the controls. Spondilolysthesis was seen in a case of L4 on L5 and four cases of L5 on S1. Schmorl node in consecutive levels of L1-2, L2-3, L3-4, L4-5, L5-S1 was seen in 6, 9, 10, 4 and 2 subjects, respectively. Fat infiltration was seen in 5 controls (8%).

### Comparison of controls and case group

284 patients with symptomatic low back pain were assessed in our study. In Table 2, demographic data of two control and case groups are compared.

Table 3 presents the comparison of frequency of different lumbosacral MRI findings between two case and control groups.

Frequency of spondilolysthesis was significantly different between case and control groups (p-value=0.000). In control group there was one case of L4 on L5 (1.69%) and four cases of L5 on S1 (6.77%) while in the case group 66 patients (23.23%) had abnormality at L5-S1 level. 23 (8.09%), 13 (4.57%), 3 (1.05%) and 2 (0.7%) patients showed spondilolysthesis at L4-L5, L3-L4, L2-L3 and L1-L2 levels, respectively. Sacralization and lumbarization rates did not differ between control and case group (p-value=0.210, both). Scoliosis showed significantly different rates between two groups (p-value=0.005) as in the control group, 3 cases (5.08%) of scoliosis to the right was seen but in the case group, 35 patients (12.32%) had scoliosis to the right and 38 patients (13.38%) showed scoliosis to the left side.

**Table 2: Comparison of demographic data between case and control groups**

| Parameter | | Total | History of low back pain | | p-value |
|---|---|---|---|---|---|
| | | | Positive | Negative | |
| Sex | Male | 170 (49.6%) | 138 (48.6%) | 32 (54.2%) | 0.43 |
| | Female | 173 (50.4%) | 146 (51.4%) | 27 (45.8%) | |
| Age | Male | 41.26 ± 11.59 | 41.74 ± 11.88 | 39 ± 9.93 | 0.099 |
| | Female | 41 (18 to 63) | 42 (18 to 63) | 39 (19 to 63) | |
| Weight | Male | 75.4 ± 13.47 | 76.8 ± 13.52 | 68.36 ± 10.8 | 0 |
| | Female | 75 (36 to 120) | 75 (36 to 120) | 68 (47 to 95) | |
| Height | Male | 169 ± 10 | 170 ± 10.29 | 164.76 ± 7.27 | 0 |
| | Female | 169 (140 to 202) | 170 (140 to 202) | 164 (145 to 180) | |
| BMI | Male | 26.33 ± 4.16 | 26.53 ± 4.10 | 25.34 ± 4.3 | 0.059 |
| | Female | 25.71 (16.26 to 47.45) | 26.02 (16.25 to 47.45) | 24.71 (17.9 to 39.91) | |
| | Normal | 135 (44.1%) | 104 (40.9%) | 31 (59.6%) | |
| | Overweight/Obese | 171 (55.9%) | 150 (59.1%) | 21 (40.4%) | |

**Table 3: Comparison of frequency of different lumbosacral MRI findings between two case and control groups**

| Parameter | | Total | History of low back pain | | p-value |
|---|---|---|---|---|---|
| | | | Positive | Negative | |
| Degenerative changes in lumbar vertebrae | Yes | 197 (57.9%) | 189 (67.3%) | 8 (13.6%) | 0 |
| | No | 143 (42.1%) | 92 (32.7%) | 51 (86.4%) | |
| Facet degenerative in lumbar vertebrae | Yes | 184 (54.1%) | 164 (58.4%) | 20 (33.9%) | 0.001 |
| | No | 156 (45.9%) | 117 (41.6%) | 39 (66.1%) | |
| Degenerative changes in lumbar disks | Yes | 291 (84.8%) | 259 (91.2%) | 32 (54.2%) | 0 |
| | No | 52 (15.2%) | 25 (8.8%) | 27 (45.8%) | |
| Canal stenosis in lumbar vertebrae | Yes | 149 (45%) | 140 (51.5%) | 9 (15.3%) | 0 |
| | No | 182 (55%) | 132 (48.5%) | 50 (84.7%) | |
| Neural foraminal stenosis in lumbar spine | Yes | 195 (57%) | 170 (60.1%) | 25 (42.4%) | 0.012 |
| | No | 147 (43%) | 113 (39.9%) | 34 (57.6%) | |
| Fat infiltration in multifidus muscle | Yes | 116 (33.9%) | 111 (39.2%) | 5 (8.5%) | 0 |
| | No | 226 (66.1%) | 172 (60.8%) | 64 (91.5%) | |

## DISCUSSION

One of the main goals of our study was to assess the relationship of low back pain and multifidus muscle fat infiltration. Our data show that there is a strong association between low back pain and fat infiltration in that muscle as in the case group, there was a 39.2% rate of fat infiltration while in the control group, this rate was only 8.5% (p-value=0.000). Per Kjaer et al. [9] have reported that fat infiltration exists in 81% of the adults and is associated with presence of low back pain at any time point in life. Julie hides et al. [10] has reported that muscular atrophy of multifidus muscle is strongly associated with chronic low back pain. There is a huge bulk of evidence supporting this concept.

Our data reveal that various types of degeneration and stenosis in lumbar spine associate with low back pain. Although these symptoms and findings are also found in healthy subjects but the difference of rates between low back pain and control groups, is statistically significant. For example, degenerative changes in lumbar vertebra is found in 67.3% of LBP cases while this rate in control group was only 13.6% (p-value=0.000). Facet degeneration in lumbar vertebrae, degenerative changes in lumbar disks, canal stenosis in lumbar vertebrae and neural foraminal stenosis in lumbar spine are also the same (all p-values <0.05). Katriina luoma et al. [11] has reported that all signs of intravertebral disc degeneration are associated with increase in risk of low back pain. Mark Hancock et al. [12] have also reported that chance of presence of LBP with disc degeneration grades of 3 and above is 5.2-fold higher. Peter Schenk et al. [8] have reported that endplate changes at L5-S1 level were significantly different between two group of LBP (29.4%-30.4%) and non-LBP (9%). The same rule applies to our findings. Not only the rate of spondololysthesis and scoliosis was significantly different between two LBP and non-LBP groups in our study but also the rate of these abnormalities was significantly higher in lower levels.

## CONCLUSION

Our findings confirm the claim that LBP is significantly associated with degenerative changes observed in lumbosacral MRI as well as fat infilitration in multifidus muscle.

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