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THE RELATIONSHIP BETWEEN CLINICAL AND IMAGING FINDINGS IN MECHANICAL THORACIC SPINE PAIN: A RETROSPECTIVE COHORT STUDY

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ABSTRACT

Objective: Back pain is a very common musculoskeletal condition that affects the quality of life. There are few studies on thoracic spine pain, and the relationship between the degree of degeneration to imaging and pain severity remains unclear. We described the characteristics, etiology and imaging findings of patients with dorsalgia.

Materials and Methods: Between 2019-2020, 200 patients who applied to our clinic with complaints of back pain were retrospectively scanned. Demographic - pain characteristics and diagnoses of the patients were recorded. Kyphosis angle, Cobb angle and vertebral heights were evaluated as thoracic direct radiography findings. Modified Pfirmann grading systems, Modic changes and disc herniations were used to detect degenerative inter-vertebral disc changes via MRI. The relationship between radiological findings and clinical features was evaluated.

Results: It was determined that 80 of 200 patients with dorsalgia required imaging examination. Postural dysfunction and myofascial pain syndrome were diagnosed in 82.5% of the patients. A statistically significant difference was found between the distributions of Pfirrmann grade according to age, the presence of pain at night, the duration of pain, gender and neuropathic pain ($p<0.001$). A statistically significant difference was found between the Modic types with the age and duration of the pain of the patients ($p=0.020$). There was no statistically significant difference between thoracic levels with Phirmann grades and Modic degeneration ($p>0.050$).

Conclusion: Postural disorder and myofascial pain syndrome is the most common cause of thoracic spine pain. The imaging method can be used for further examination of the diagnosis. The pfirrmann grade and the modic changes increase with age. However, there is no clarity on the relationship between such changes and the severity of back pain. Methods for the recognition, prevention and reporting of pain should be developed.

Keywords: Dorsalgia, upper back pain, magnetic resonance imaging, degeneration, thoracic spine pain

INTRODUCTION

Thoracic spine pain (TSP) involves the area between the cervicothoracic (C7-T1) and thoracolumbar (T12-L1) junctions. For dorsalgia, different from the cervical and lumbar spine, the first thing to consider is to distinguish between visceral and musculoskeletal pain. Many diseases that are reflected in these areas may cause pain in patients with back pain. Therefore, the patient should be handled in detail. The imaging method can be used as further examination for the diagnosis. However, the most common cause of dorsalgia is musculoskeletal diseases.

Pain is defined as an unpleasant experience that is felt as a result of actual or possible tissue damage and is affected by many psychological and physiological variables[1]. Acute pain is the biological symptom of a nociceptive stimulation that lasts 3 months or less, caused by tissue damage as a result of disease or trauma[1,2]. Chronic pain is usually defined as 3 months or more. It has been determined in general population studies that the most common area of chronic pain is the back and waist region[1,2].

Dorsalgia prevalence was found to be 7-38% in small-scale studies. The incidence of thoracic disc lesions affecting the spinal cord is one case per million people per year and generally affects adults[3,4]. It has been reported that back pain is observed in 75% of the working population, especially in industrialized countries[1]. The most common causes of dorsalgia are posture disorder and painful muscle syndromes such as myofascial pain syndrome (MPS) and fibromyalgia syndrome (FMS). Osteoporotic vertebral fracture, degenerative diseases, spondyloarthropathies, discopathies are diseases that should be considered in the differential diagnosis[5-8]. 85% and over of people will suffer myofascial pain at least once in their lifetime. Men and women are affected equally. Acute strain, sudden-overload, accumulated trauma, emotional stress, poor posture, immobilization for a long time, spinal curvature, mineral and vitamin deficiency, metabolic and endocrine

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diseases, sleep disorders are some of the reasons that cause MPS formation and its continuation. The diagnosis is made by physical examination and detailed history. MPS is often confused with FMS[9,10]. Degenerative changes of the thoracic spine have seemed in approximately half of the asymptomatic cases. Thoracic disc protrusions are much less widespread clinically than those in the lumbar spine due to greater stiffness of the thoracic spine. This is partly a result of the stabilizing effect of the rib cage on the thoracic spine and partly due to thinner thoracic intervertebral discs due to a less voluminous nucleus pulposus (NP). Therefore, the extension and flexion movements of the thoracic spine are in a smaller range. The TSP can also cause pain radiating along the ribs and chest pain. Pain may increase in situations that increase intra-abdominal pressure, such as deep breathing and coughing. May be confused with a heart attack or angina. Using magnetic resonance imaging (MRI), interpretation and scoring of structural changes of disc degeneration, narrowing of disc space, endplate changes, disc protrusion, facet arthropathy, osteophyte formation, NP and annulus fibrosus shape are accepted to assess the degree of disc degeneration.

However, there is no clarity as to the relationship of such changes to the severity of back pain. In addition, the relationship between degree of degeneration on imaging and pain intensity remains unclear[11].

In our study, we aimed to evaluate the characteristics and diagnoses of our patients with dorsalgia and the findings of the patients who were evaluated radiologically.

MATERIALS AND METHODS

Between 2019 and 2020, 200 patients who applied to our clinic with TSP were retrospectively screened. Acıbadem University Ethics Committee (ATADEK-2019/19) approved the study, and each individual signed a detailed written informed consent form for the study (2019-19/2).

Participants

Demographic data (age, gender), clinical characteristics (pain duration, pain that wakes you up at night, neuropathic pain component) and the diagnosis of the patients were recorded.
Pain duration was rated as acute <3 months, chronic >3 months. In terms of pain intensity, we recorded pain duration and night pain. Neuropathic pain component (pricking, tingling, pins and needles; electric shocks; hot or burning sensations; and pain evoked by light touching) was recorded.

Thoracic Direct Radiography Imaging Protocol

Anterior-posterior (70-80 kVp and 25-40 mAs) and lateral (80-100 kVp and 40-80 mAs) views the thoracic spine were evaluated. Kyphosis angle, Cobb angle and vertebral heights were evaluated as thoracic direct radiography findings. The angle of kyphosis between 20-45° was accepted as normal. It was evaluated as <20° hypokyphosis, 45°> hyperkyphosis. Cobb angle was evaluated as <10° spine curvature and >10° as scoliosis. Vertebra height was measured. Height loss of over 25% was recorded as a vertebral fracture.

Magnetic Resonance Imaging Protocol

Modified Pfirmann grading system, Modic changes (MC) and disc herniations were used to detect degenerative intervertebral disc changes via MRI. A 1.5-T MRI scanner was used to obtain data. T2-weighted sagittal images (TR=3500 ms, TE=120 ms, slice thickness=4 mm, flip angle=140, matrix=512x512, field of view=480x480, NEX=2), T1-weighted sagittal images (TR=450 ms, TE=20 ms, slice thickness=4 mm, flip angle=90, matrix=512x512, field of view=480x480, NEX=2), T2-weighted axial images (TR=3500 ms, TE=120 ms, slice thickness=4 mm, flip angle=140, matrix=256x256, field of view=240x240, NEX=2) were evaluated.

Statistical Analysis

The data were analyzed with IBM SPSS V23. Conformity to the normal distribution was evaluated using the Shapiro-Wilk test. The chi-square and Fisher's Exact tests were used to compare categorical data according to groups. The Mann-Whitney U test was used to compare the age that was not normally distributed according to the kyphosis angle, and the Kruskal-Wallis test was used to compare the age that was not normally distributed according to the cobb angle. Analysis results mean ± S for quantitative data. The categorical data as deviation and median (minimum-maximum) were presented as frequency (percentage). The level of significance was taken $p<0.050$.

RESULTS

When the general characteristics of 200 patients who applied to our clinic due to dorsalgia were examined, it was seen that 66% were female and the average age was 34.6. It was found that the pain duration of 68.3% of the patients was <3 months. It was observed that 35.8% of the patients woke up with back pain at night and 32.3% of the patients had a neuropathic pain component. It was found that 82.5% of the patients were diagnosed with posture disorder and myofascial pain syndrome. Radiological imaging was requested from 80 of 200 patients. Whole vertebral column radiography was requested for 43 of 80 patients. In 14% of these patients, the kyphosis angle was measured as 20° and below. Scoliosis was found in 16.2% of the patients (Cobb angle >10°), and spine curvature was found in 20.9% (Table 1).
There was no statistically significant difference between the distribution of the characteristics of the patients according to the angle of kyphosis ($p>0.050$).
A statistically significant difference was found between the distributions of pain duration according to the Cobb angle ($p=0.029$). 80% of patients with a cobb angle >10° and 11.1% of patients with a Cobb angle of <10° were found to have chronic pain.

There is no statistically significant difference between the distributions of other variables according to the cobb angle (p>0.050) (Table 2).

MRI was requested from 37 of 200 patients. A statistically significant difference was found between the distributions of the phirmann grades system according to age groups (p<0.001). 2% of the patients between the ages of 31 and 40 were found to be grade 2 and 5.6% as grade 5. While 10.8% of the patients >41 years were obtained as grade 2, 1.7% of them were evaluated as grade 5.

A statistically significant difference was found between phirmann grade distributions according to the duration of pain (p=0.002). 1.2% of those with acute pain and 4.1% of those with chronic pain were achieved as grade 4. It was obtained as Grade 5 in 5.4% of those with chronic pain.

Table 1. General characteristics of the patients

	Frequency (n)	Percent (%)
Gender		
Female	132	66.0
Male	68	34.0
Age (mean ± SD)	34.6±12.0	33.0 (10.0-90.0)
Pain duration		
Acute (<3 months)	136	68.3
Chronic (>3 months)	63	31.7
Pain that wakes you up at night		
No	124	64.2
Yes	69	35.8
Neuropathic pain component		
No	130	67.7
Yes	62	32.3
Diagnosis		
FMS	5	2.5
Posture disorder and MPS	165	82.5
Scoliosis	7	3.5
Cervical disc herniation	4	2
Thoracic disc herniation	14	7
Zona	2	1.0
Compression fracture	3	1.5
Kyphosis angle		
Normal	37	86.0
<20°	6	14.0
Cobb angle		
Normal	27	62.7
>10°	7	16.2
<10°	9	20.9

FMS: Fibromiyalgia syndrome, MPS: Myofacial pain syndrome, SD: Standard deviation

A statistically significant difference was found between the phirmann grading system according to the presence of pain that awakens from sleep at night (p=0.003). 4.3% of the pain that awakens from sleep at night and 1.4% of those without night pain were found to be grade 4. 5.3% of those with night-time pain and 0.7% of those without night pain were achieved as grade 5.

A statistically significant difference was found between the distributions of phirman grades according to the presence of neuropathic pain (p=0.001). While 2.4% of those without neuropathic pain and 6.7% of those with pain were grade 1, 5.3% of those without pain and 15.8% of those with pain were achieved as grade 2.

A statistically significant difference was found between the distributions of phirmann grades according to gender (Table 3).

A statistically significant difference was found between the distributions of Modic types according to age groups and pain duration (p=0.02). Eleven of the patients <30 years old were seen as Modic type 1, 12 of the patients aged 31-40 years as modic type 2, and 5 patients >41 years as Modic type 1. Modic type 2 degeneration was detected in 14 patients with chronic back pain (Table 4).

There was no statistically significant difference between the distribution of disc herniation types according to the characteristics of the patients (p>0.05) (Table 5).

There is no statistically significant difference between the distributions of thoracic levels according to Phirmann grades and Modic types (p>0.050) (Table 6 and 7).

DISCUSSION

Spinal pain results in significant disability and work time loss. Very few studies have been done in the general population to define the etiology and prevalence of TSP. In the study of Udby et al.[3], one of the causes of thoracic pain was found to be myofascial pain syndrome in 85%[4]. In our study, 82.5% of our patients were diagnosed with posture disorder and myofascial pain syndrome. An osteoporotic compression fracture in 3 patients, hypokyphosis in 6 patients, scoliosis in 7 patients, and spinal curvaturein 9 patients were detected by direct radiography. 80% of patients with scoliosis were found to have chronic pain.

Fouquet et al.[12], in their study with 3710 worker, found that the frequency of TSP in women was associated with biological predisposition and repetitive loading. They found that TSP is 7 and 30% in men and between 9 and 38% in women, as in our study[4].

Dorsalgia is relatively low in young and middle-aged people and increases with age. Most of the vertebral fractures are asymptomatic and have been detected in 20% of postmenopausal women. It is most commonly seen as a wedge-type compression fracture[4]. A cross-sectional study of men and women aged >50 years found signs of degeneration at least one vertebral level in 84% of men and 74% of women[13].

Muscle weakness and degenerative changes in the spine cause hyperkyphosis. Also, at least 40% of people with hyperkyphosis have a vertebral fracture, and the angle of kyphosis increases by 3.8° with each vertebral fracture[14]. In our study, we looked at the angle of kyphosis based on this aspect, but there was no patient with hyperkyphosis.

In recent years, MRI is the imaging method of option for examining the thoracic spinal canal. It provides a quality image along the entire length of the spine and can determine the morphology of the discs and cord. It has become a widely used diagnostic imaging modality for patients suffering from back pain and related disability. Certain imaging findings, such as nerve entrapment and severe canal narrowing, show a strong association with patient-reported outcomes, while other signs of degeneration found on MRI have a more dubious clinical relevance. Disc degeneration (DD), MC and facet joint

Table 2. Relationship of patients' characteristics with kyphosis and Cobb angle

	Kyphosis angle <20°	p	Cobb >10°	<10°	p[1]
Gender					
Female	5 (83.3)	1.000[1]	4 (57.1)	7 (77.8)	0.510
Male	1 (16.7)		3 (42.8)	2 (22.2)	
Pain duration					
Acute (<3 months)	5 (83.3)	0.192[1]	2 (28.5)[b]	8 (88.9)[a]	**0.029**
Chronic (>3 months)	1 (16.7)		5 (71.4)	1 (11.1)	
Pain that wakes you up at night					
No	5 (83.3)	0.375[1]	5 (71.4)	4 (44.4)	0.432
Yes	1 (16.7)		2 (28.5)	5 (55.6)	
Neuropathic pain component					
No	4 (66.7)	0.611[1]	7 (100)	5 (55.6)	0.143
Yes	2 (33.3)		0 (0)	4 (44.4)	
Age					
<30 years	3 (50)		3 (42.8)	2 (22.2)	0.625
31-40	1 (16.7)	0.4032	4 (57.1)	4 (44.4)	
>41	2 (33.3)		0 (0)	3 (33.3)	

Kyphosis angle: [1]Fisher's Exact test, [2]Chi-square test
Cobb angle: [1]Chi-square test, [a,b]: There is no difference between groups with the same

Table 3. Patients characteristics and Pfirrmann grading system relationship

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	p[1]
Gender						
Female	13 (3.4)	30 (7.8)	3 (0.8)	8 (2.1)	11 (2.9)	0.629
Male	4 (3.7)	9 (8.3)	2 (1.8)	5 (4.6)	2 (1.8)	
Age						
<30 years	9 (5.1)	22 (12.5)[a]	1 (0.6)	5 (2.8)	0 (0)[a]	
31-40	6 (3)	4 (2)[b]	1 (0.5)	5 (2.5)	11 (5.6)[b]	**<0.001**
>41	2 (1.7)	13 (10.8)[a]	3 (2.5)	3 (2.5)	2 (1.7)[ab]	
Pain duration						
Acute (<3 months)	10 (4)	21 (8.3)	2 (0.8)	3 (1.2)[a]	0 (0)[a]	**0.002**
Chronic (>3 months)	7 (2.9)	18 (7.4)	3 (1.2)	10 (4.1)[b]	13 (5.4)[b]	
Pain that wakes you up at night						
No	10 (3.5)	28 (9.8)	4 (1.4)	4 (1.4)[a]	2 (0.7)[a]	**0.003**
Yes	7 (3.4)	11 (5.3)	1 (0.5)	9 (4.3)[b]	11 (5.3)[b]	
Neuropathic pain component						
No	9 (2.4)[a]	20 (5.3)[a]	4 (1.1)	8 (2.1)	11 (2.9)	**0.001**
Yes	8 (6.7)[b]	19 (15.8)[b]	1 (0.8)	5 (4.2)	2 (1.7)	

[1]Chi-square test, [a,b]: There is no difference between groups with the same letter

degeneration (FJD) are spinal imaging findings and possible causes. Several different grading systems have been used to classify the severity of these degenerative changes[11,15]. In the study of Udby et al.[3], lumbar spine DD and FJD were not associated with long-term disability. In our study, 37 of the patients required evaluation with MRI. Phirmann grades and modic classification were used to evaluate degenerative changes. 5,6% of the patients between the ages of 31-40 were found to be grade 5. While 1.7% of the patients aged >41 were obtained as grade 5. 11 of the patients <30 years old were seen as Modic type 1, 12 of the patients aged 31-40 years as Modic type 2. Nine of the patients had bulging, 1 had extrusion and 8 had protrusion. There was no statistically significant difference between the distribution of disc herniation types according to the characteristics of the patients.

Recent studies have also confirmed that symptomatic thoracic disc prolapses are between 0.15 and 4% of all intervertebral disc prolapses. However, the clinical diagnosis is often not

Table 4. Patients characteristics and Modic clasiffication relationship

	M1	M2	M3	p[1]
Gender				
Female	17 (4.9)	15 (4.3)	0 (0)	0.155
Male	2 (2.2)	3 (3.3)	1 (1.1)	
Age				
<30 years	11 (7.3)[a]	5 (3.3)	0 (0)	**0.020**
31-40	3 (1.7)[b]	12 (6.7)	0 (0)	
>41	5 (4.5)[ab]	1 (0.9)	1 (0.9)	
Pain duration				
Acute (<3 months)	10 (4.3)	4 (1.7)[a]	0 (0)	**0.047**
Chronic (>3 months)	9 (4.3)	14 (6.7)[b]	1 (0.5)	
Pain that wakes you up at night				
No	11 (4.4)	6 (2.4)	1 (0.4)	0.176
Yes	8 (4.2)	12 (6.3)	0 (0)	
Neuropathic pain component				
No	8 (2.4)[a]	17 (5)	0 (0)	**<0.001**
Yes	11 (11)[b]	1 (1)	1 (1)	

[1]Chi-square test, [a,b]: There is no difference between groups with the same letter

Table 5. Patients characteristics and disc herniation relationship

	Bulging	Protrusion	Extrusion	p[1]
Gender				
Female	7 (46.7)	7 (46.7)	1 (6.7)	0.779
Male	2 (66.7)	1 (33.3)	0 (0)	
Age				
<30 years	4 (57.1)	3 (42.9)	0 (0)	0.782
31-40	3 (42.9)	3 (42.9)	1 (14.3)	
>41	2 (50)	2 (50)	0 (0)	
Pain duration				
Acute (<3 months)	4 (44.4)	5 (55.6)	0 (0)	0.447
Chronic (>3 months)	5 (55.6)	3 (33.3)	1 (11.1)	
Pain that wakes you up at night				
No	5 (55.6)	3 (33.3)	1 (11.1)	0.447
Yes	4 (44.4)	5 (55.6)	0 (0)	
Neuropathic pain component				
No	6 (46.2)	6 (46.2)	1 (7.7)	0.758
Yes	3 (60)	2 (40)	0 (0)	

[1]Chi-square test

Table 6. Phirmann grade and thoracic spine levels

	Grade 1	Grade 2	Grade 3	Grade 4	P[1]
Toracal level					
T1-T2	0 (0)	1 (2.6)	1 (20)	0 (0)	
T2-T3	1 (5.9)	5 (12.8)	1 (20)	1 (7.7)	
T3-T4	3 (17.6)	2 (5.1)	0 (0)	2 (15.4)	
T4-T5	2 (11.8)	5 (12.8)	0 (0)	3 (23.1)	
T5-T6	2 (11.8)	5 (12.8)	0 (0)	2 (15.4)	
T6-T7	1 (5.9)	4 (10.3)	0 (0)	3 (23.1)	0.984
T7-T8	2 (11.8)	5 (12.8)	1 (20)	1 (7.7)	
T8-T9	2 (11.8)	4 (10.3)	1 (20)	1 (7.7)	
T9-T10	2 (11.8)	3 (7.7)	0 (0)	0 (0)	
T10-T11	1 (5.9)	2 (5.1)	0 (0)	0 (0)	
T11-T12	1 (5.9)	3 (7.7)	1 (20)	0 (0)	

[1]Chi-square test

Table 7. Modic and thoracic spine levels

	M1	M2	M3	p[1]
T1-T2	0 (0)	1 (5.6)	0 (0)	
T2-T3	1 (5.3)	1 (5.6)	0 (0)	
T3-T4	0 (0)	2 (11.1)	0 (0)	
T4-T5	2 (10.5)	4 (22.2)	1 (100)	
T5-T6	4 (21.1)	2 (11.1)	0 (0)	0.687
T6-T7	2 (10.5)	1 (5.6)	0 (0)	
T7-T8	3 (15.8)	1 (5.6)	0 (0)	
T8-T9	2 (10.5)	3 (16.7)	0 (0)	
T9-T10	3 (15.8)	1 (5.6)	0 (0)	
T10-T11	2 (10.5)	2 (11.1)	0 (0)	

[1]Chi-square test

identifiable, and patients are often classified as suffering from intercostal neuralgia, neuritis, cardiac neurosis, or pleurodynia. Thoracic disc protrusions are clinically much less common than those in the lumbar spine due to greater stiffness of the thoracic spine. This is partly a result of the stabilizing effect of the rib cage on the thoracic spine and is due to the thinner thoracic intervertebral discs. Therefore, the extension and flexion movements of the thoracic spine are in a smaller range. Small thoracic disc lesions are most common between T4 and T8. Those with cord compression are usually in the lower half of the rib cage. About 70% are between T9 and T12, the most common level (29%) is T11. In our study, 14 patients had thoracic disc herniation and 4 patients had cervical disc herniation. Also, In our study, no correlation was found between spinal levels and Modic types, disc herniation and phirmann grading[3,16].

Study Limitations

We had some limitations. One of the limitation was not recording the occupations of the patients. Another limitation of our study was that comorbid diseases were not evaluated. In the study of Rabal-Pelay et al.[17] they found that office workers arise pain in the upper back significantly at the end of the day. de Luca et al.[18] found that individual comorbid chronic diseases were significantly associated with spinal pain and a correlation between increased number of comorbidities and spinal pain. Our study may be a precursor for prospective studies with larger number of patients.

CONCLUSION

In conclusion, we defined the characteristics of the patients presenting with dorsalgia in our study. We wanted to point about the differences in the neck and lumbar spine pain. Posture disorder and myofascial pain syndrome is the most common cause of back pain. The imaging method can be used as further examination in the diagnosis. However, there is no clarity as to the relationship of such changes to the severity of back pain. Methods for the recognition, prevention and reporting of pain should be developed.

Ethics

Ethics Committee Approval: Acıbadem University Ethics Committee (ATADEK-2019/19) approved the study.
Informed Consent: Each individual signed a detailed written informed consent form for the study (2019-19/2).
Peer-review: Internally peer-reviewed.
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