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IMPORTANCE OF THE SPINE MAPPING SYSTEM IN ANKYLOSING SPONDILITIS

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Abstract

Ankylosing spondylitis (AS) is an autoimmune autoinflammatory disease with inflammatory processes of the spine and sacroiliac joints. Radiographic examinations are one of the main tools in diagnosing AS and assessing the dynamics of disease development. Correct and systematic visualization examinations allow to identify structural changes in the sacroiliitis and spine even in the early stages of the disease. This article reviews the use of radiographic techniques, including computed tomography (CT) and magnetic resonance imaging (MRI), in the diagnosis of AS. The article also analyzes the importance of evaluating the disease through the mapping system of sacroiliac joint and spinal injuries. The mapping system allows for a complete understanding of structural changes and their step-by-step tracking.

Purpose: to study the importance of the mapping system in the detection and assessment of radiographic changes in ankylosing spondylitis (AS) and axial spondyloarthritis, to analyze the mechanisms of assessment of structural changes in the sacroiliac joint and spine through imaging methods, including CT and MRI examinations. Determining the stages of the disease based on the mapping system, evaluating the effectiveness of treatment and considering individual approach methods.

Materials and methods: A total of 170 patients diagnosed with ankylosing spondylitis (AS) and axial-spondyloarthritis (axial-SpA) were studied in this study. Patients were divided into two groups: AS group (n=65), Axial-SpA group (n=105).

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MRT, CT, UTT and X-ray methods were used for radiographic examination. During the study, ASAS, ASR classification criteria were used for diagnosis. Disease activity in patients was assessed using the BASDAI index. mSASSS (modified Stoke Ankylosing Spondylitis Spinal Score) was used to evaluate structural changes. A map of radiographic changes frequency, stages, and developed structural changes was made in each group of patients.

Results: In this study, different types of spinal cord damage in axial spondyloarthritis (axial-SpA) and ankylosing spondylitis (AS) were compared in radiographic examinations. In case of 19.5% of signs of osteitis in axil-SpA, this indicator is 5 times higher in AS (P<0.001). In case 2, enthesitis and paravertebral inflammation were up to 17.2% in axial-SpA and 7.4% in AS. In view 3, fluid density and osteoporosis were 28.7% lower in axil-SpA and 3 times lower in AS (P<0.001). In view 4, 10-25% thinning and thickening of the vertebral column was the same in both groups (P>0.05). In view 5, 25-50% increase in vertebral diameter and "triangular" shape changes occurred 4 times more often in AS compared to others (P<0.001). In view 6, 25-50% thinning of the vertebrae and 50-75% thickening were found twice more in ACS (P<0.05). In view 7, syndesmophytes were 7.3% in axil-SpA and 16.6% in AS.

Key words

Ankylosing spondylitis, axial spondyloarthritis, sacroiliitis, erosive ȳzgarishlar, enthesopathy, osteophyte, tenosynovitis, magnetic resonance imaging (MRI), computer tomography (CT), ASAS, BASDAI, mSA

Ankylosing spondylitis (AS) is a chronic inflammatory arthritis of the seronegative spondyloarthritis, primarily affecting the spine and sacroiliac joint. External environmental factors, smoking, alcohol and genetic factors significantly aggravate the course of the disease. At the same time, the intestinal microflora also affects the pathophysiology of the disease. The association of AS with the HLA-B27 gene, IL23R, ERAP1 genes, immunological cells and a number of cytokines are factors that determine the clinical course and prognosis of the disease. Between the ages of 18-30, the onset of the disease is higher among men than among women. It is known that women have lower incidences, diagnostic delays and increased disease activity, as well as differences in the effectiveness of drugs, depending on gender. Studies have examined more than 100 disease-related genes, most of which are strongly associated with IL-23 and IL-17 cytokines and antigen presentation. According to the World Health Organization (WHO), the incidence of AS is expected to increase by 50% in the next 30 years. Despite the fact that this disease is the most studied of all spondyloarthritis, it has not found a complete cure.

Pharmacological drugs and rehabilitation measures can control the symptoms of the disease, reduce its progression (ankylosis and deformity of the spine and sacroiliac joint) and maintain optimal function. In most cases, non-steroidal anti-inflammatory drugs are effective in reducing inflammation, pain and joint stiffness. Of the basic antirheumatic drugs, TNF-α inhibitors from sulfasalazine and β-DMARDs, IL-17 |inhibitors and JAK inhibitors from ts-DMARDs are gaining importance. In ankylosing spondylitis, structural and structural damage occurs as a result of the formation of syndesmophytes and the development of irreversible ankylosis in the spine. In turn, evaluating these changes and the effectiveness of treatment requires radiographic observations. It is important to create a mapping system based on these radiographic findings and the assessment of structural changes in the spine. The criteria of Modified Stoke Ankylosing Spondylitis Spinal Score (mSASSS), Bath Ankylosing Disease Activity Index (BASDAI) and Assessment of SpondyloArthritis International Score (ASAS) are important in assessing radiographic progression, symptoms and signs of the disease, deterioration of spinal mobility and functions. Ankylosing spondylitis is a type of axial spondyloarthritis, in which an inflammatory process in the sacroiliac region is detected on X-ray examination. In the early stages of axial spondyloarthritis, radiographic examination does not show ankylosis in the spine. For this reason, diagnostic difficulties of this disease still exist. If X-ray examination does not confirm AS, an MRI examination is required. During the disease, osteodestructive changes rarely occur. Erosive and sclerotic changes are observed in the early stage of radiographic changes, leading to the development of syndesmophytes, vertebral ankylosis and the formation of "bamboo spine". Syndesmophyte and ankylosis are pathognomonic structural changes of the disease. A number of BASRI and mSASSS assessment indicators are used to evaluate disease progression, radiographic monitoring of structural changes, and treatment efficacy. According to the Assessment of SpondyloArthritis International Score (ASAS), mSASS is the preferred method for assessing radiographic progression in ankylosing spondylitis. Cervical (S2-S7) and lumbar (L1-L5) vertebrae are evaluated. The total score is from 0 to 72 points, Score 0: normal appearance (no changes), Score 1: erosion and sclerotic changes are present, Score 2: presence of syndesmophytes, Score 3: presence of ankylosis. Through the mapping system, it is possible to study syndesmophytes or new bone growths, the development of ankyloses and the effectiveness of the therapy being carried out depending on the progression of the disease. In addition, it is possible to determine the stage of the disease and the level of damage, and select biological treatment and other therapies through an individual approach. Ankylosing Spondylitis spine Magnetic Resonance Imaging-

activity score, Berlin modification of the Ankylosing Spondylitis spine Magnetic Resonance Imaging-activity, Spondyloarthritis Research Consortium of Canada score, Canada-Denmark scoring system There are also a number of scoring systems based on structural changes in MRI examinations, but clinical errors related to the development of the disease occur due to the fact that the images taken in practice are not always properly analyzed and there is a lack of specialists. It is precisely in AS that creating a perfect map of the spine based on radiographic examinations has a positive effect on the diagnosis and management of the disease. CT and MRI scans of the spine and sacroiliac joints in patients with AS revealed some differences between AS (n=65) and axial-SpA (n=105). In particular, the formed erosive changes were significantly different in AS patients compared to axial-SpA patients ($r<0.05$) and these changes occurred in 45.3% of AS cases, while this indicator was observed in 30.8% of axial-SpA cases. Also, tendovaginitis was 34.5% in AS versus 24.7% in patients with axial-SpA, and changes in enthesopathy showed 54.9% versus 39.9%. Interestingly, the combination of formed osteitis foci with erosive changes was observed twice as often in AS cases in 73.6% of cases ($r<0.05$) compared to 36.3% of axial-SpA patients. Epiphyseal osteoporosis was recorded in 40.8% of patients with AS, and axial-SpA in 52.6%. Subchondral sclerosis was observed in 42.2% of AS patients, 52.6% in axial-SpA, osteophytosis in 36.8% of AS and 53.8% in axial-SpA. Meniscal branch abnormalities were not significantly different between the two groups of patients, 11.8% versus 7.6%, and chondroma and Goff corpuscle formation were more common in AS patients. These data show the role of visualization methods in distinguishing the structural changes of diseases belonging to the group of spondyloarthritis.

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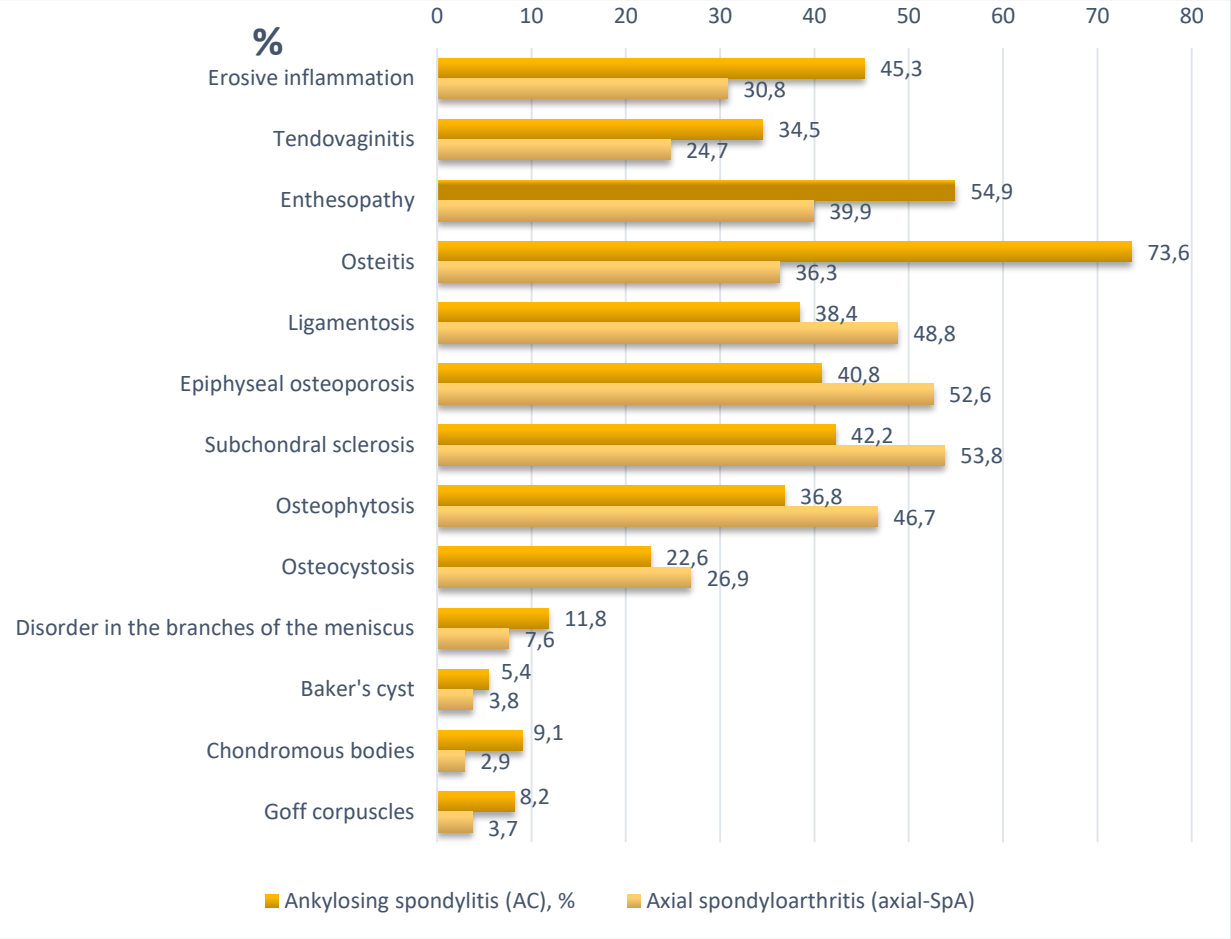

Graph 1. Occurrence rate of MRI and sonographic signs in patients with axial-SpA and AS.

It is known that spondyloarthritis is mainly accompanied by inflammation of the ileo-cecal joint, that is, sacroiliitis.

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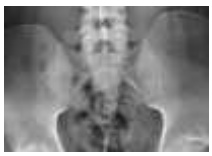
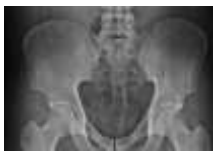
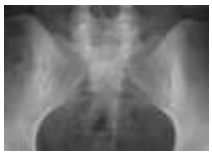
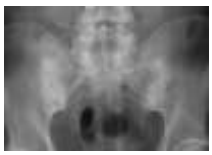
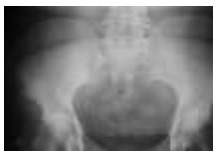
Table 1. Incidence of sacroiliitis in patients with SpAs according to radiographic stages (Kellgren J.H., Jeffrey M.R.)

The stages		Groups	Encounter rate		Bilateral	
			abs	%	abs	%
	Stage 0	Group I, n=65 (Ankylosing spondylitis (AS))	0	0	0	0
		Group II, n=105 (Axial spondyloarthritis (axial-SpA))	6	5,7	0	0
		Total, n=170	6	3,53	0	0
	Stage 1	Group I, n=65 (Ankylosing spondylitis (AS))	12	18,46	8	13,3
		Group II, n=105 (Axial spondyloarthritis (axial-SpA))	27	25,7	5	4,7
		Total, n=170	39	22,9	13	7,65
	Stage 2	Group I, n=65 (Ankylosing spondylitis (AS))	18	27,69	11	16,9
		Group II, n=105 (Axial spondyloarthritis (axial-SpA))	31	29,52	4	3,8
		Total, n=170	49	28,8	15	8,8
	Stage 3	Group I, n=65 (Ankylosing spondylitis (AS))	7	10,7	13	20
		Group II, n=105 (Axial spondyloarthritis (axial-SpA))	24	22,83	7	6,67
		Total, n=170	31	18,2	20	11,7
	Stage 4	Group I, n=65 (Ankylosing spondylitis (AS))	3	4,6	7	10,7
		Group II, n=105 (Axial spondyloarthritis (axial-SpA))	17	16,2	5	4,76
		Total, n=170	20	19	12	7
Total					60	35,15

Note: * - $p<0.05$ is the level of reliability of the difference between groups.

According to the obtained results, the AS form of SpA differed from axial-SpA by lower stages of sacroiliitis and, moreover, by symmetry indicators. In particular, as can be seen from table 2, in patients with axial SpA, the X-ray stage 1 of

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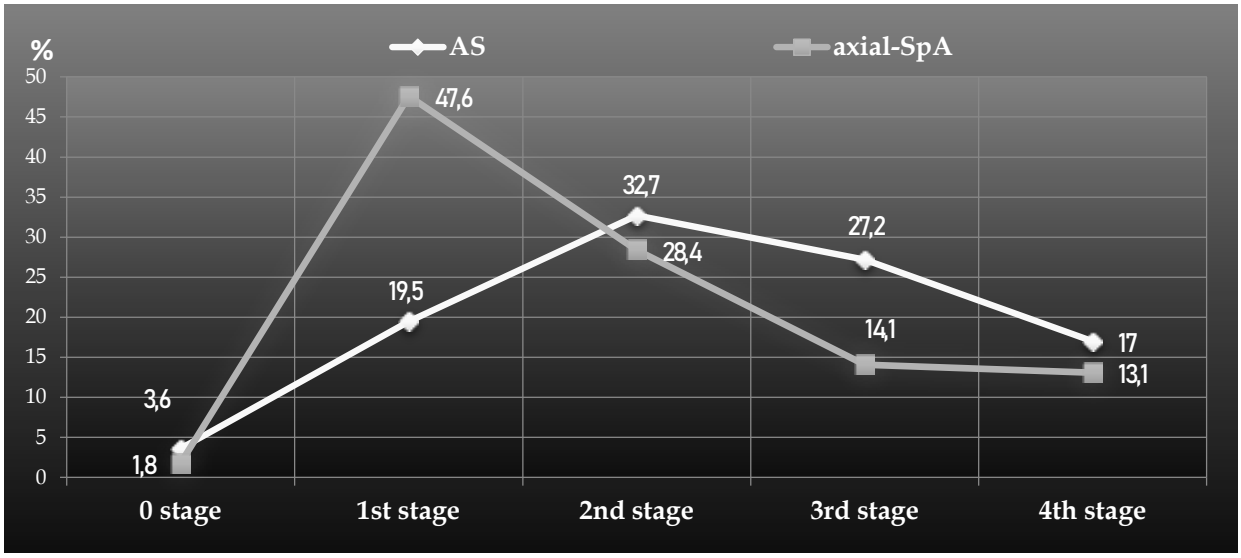
sacroiliitis was 2 times higher than in the form of AS. On the contrary, the 3rd and 4th stages of the disease were 3.5 times more common in patients with the AS form than in the other form. Allbatta AS n=65 patients and axial-SpA were obtained compared to n=105 patients.

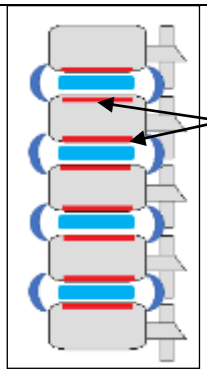


Graph 2. Comparative view of the degree of occurrence of sacroiliitis according to the form of SpA.

As shown in Table 3, the incidence rate of axial-SpA increased as ileo-cecal joint damage increased in patients with AS. Axial-SpA, on the other hand, decreased. In addition, when comparing the symmetry of the sacroiliitis between the groups, its symmetric, i.e., bilateral damage was 33.3% in ankylosing spondylitis, while it was found in only 12% of patients with axial SpA. As can be seen from table 2, sacroiliitis became bilateral mainly in the 3rd and 4th stages.

It is well known that there are difficulties with MRI analysis for practicing doctors. Therefore, the assessment of structural changes in the spine mapping system is of scientific and practical importance.

Table 2. Abnormalities identified by a spinal structure mapping system in a patient with AS

Characteristics of mapping structural changes	Elements of spinal structure mapping
"Appearance 1"	 "Symptoms of osteitis (inflammation)" detected in the upper and lower parts of the spine"

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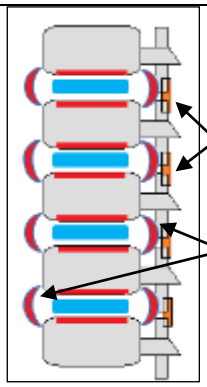
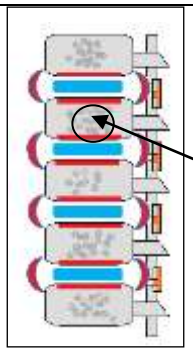
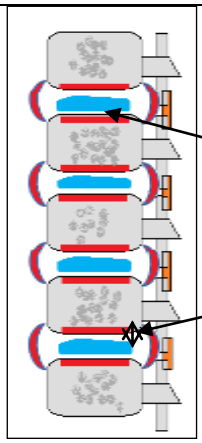
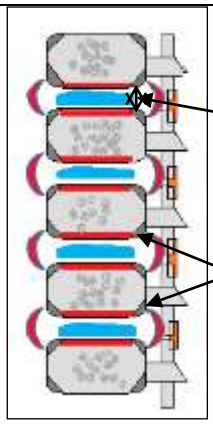
(to appearance 1 +) "appearance 2"	 Formed enthesitis; Thickening of paravertebral tissue
(to appearance 2 +) "appearance 3"	 A pronounced decrease in bone density, the formation of osteoporosis
(to appearance 3 +) "appearance 4"	 Thinning of the intervertebral disc to 10-25%; Spine spacing narrowing to 10-25%
(to appearance 4 +) "appearance 5"	 Spine spacing narrowing to 25-50%; "Triangular" focal changes at the corners of the vertebral body

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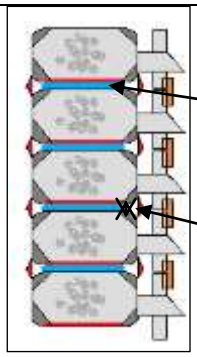
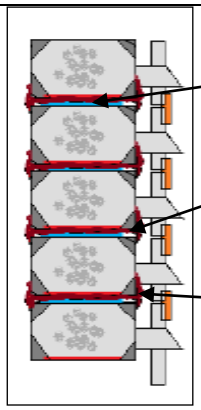
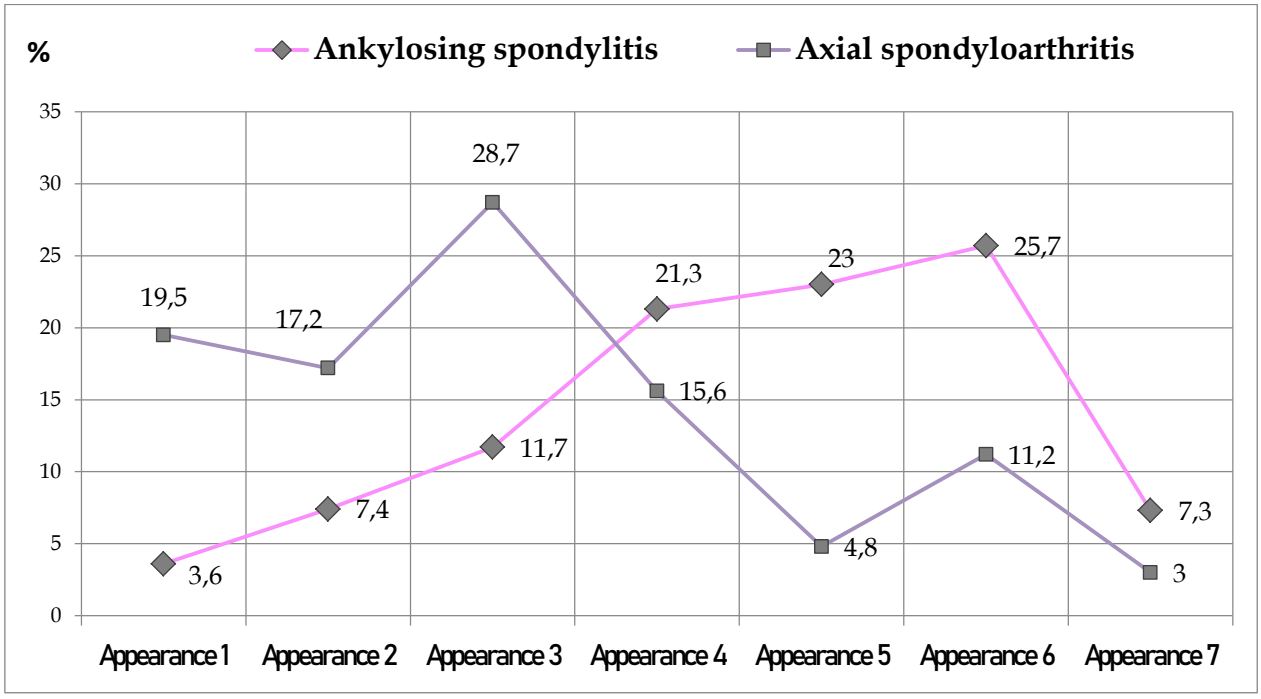
(to appearance 5 +) "appearance 6"	 Thinning of the intervertebral disc to 25-50% Spine spacing narrowing to 50-75%
(to appearance 6 +) "appearance 7"	 Thinning of the intervertebral disc to 50-75% Spine spacing narrowing to 75-100% Syndesmofit formation

Using a "mapping system" of disorders in the structures of the spine, it is possible to identify specific manifestations and early changes of the disease in patients with AS. Therefore, the changes in the spine in the patients included in the study were transformed into the "mapping views" presented in Table 2, according to the analysis of digital technology. Based on the identified structural changes, it was divided into 7 different "views".



Graph 3. Comparative analysis of the level of "mapping features" of damage to the spine according to the forms of spondyloarthritis.

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As can be seen from the diagram in graph 3, the damage of the spine in AS begins with “osteitis (inflammation) signs” in the upper and lower parts of the initial vertebral body. Axial-SpA with conditional sign “1st view” of this mapping was found in 19.5% of patients, and AS form was observed almost 5 times more ($p<0.001$). Enthesitis formation and inflammation of paravertebral tissues are characteristic of osteitis in “2-view”, which was detected in 7.4% of patients in AS, and in 17.2% of patients in axial-SpA. On the other hand, “View 3” includes a significant decrease in bone density and osteoporosis, which was reflected in 28.7% of patients in axial-SpA, and in AS it was 3 times less common ($p<0.001$). “View 4” includes “thinning of the intervertebral disc up to 10-25% and narrowing of the intervertebral space up to 10-25%” to the above-mentioned structural changes, and the two groups did not differ from each other in terms of its incidence ($p>0.05$). “View 5” includes "narrowing of the vertebral space up to 25-50% and “triangular” focal changes in the corners of the vertebral body" and, on the contrary, in patients with AS, the incidence is 4 times higher than in other forms ($p<0.001$).) is common. On the other hand, the “6th view” of the mapping, i.e., the progression of structural changes in the spine, is characterized by “thinning of the intervertebral disc up to 25-50% and narrowing of the intervertebral space up to 50-75%, which is 2 times more common in AS compared to the other form ($p>0.05$) was found to be abundant. In the vertebral column, syndesmophyte formation was designated as "7th appearance” and was accompanied by further thinning of the intervertebral disc by 50-75% and narrowing of the intervertebral space by 75-100%. According to the obtained results, this phenomenon was more common in AS and accounted for 7.3%. Some differences were also found when analyzing the characteristics of spinal cord damage according to the clinical course of AS. In particular, as shown in the diagram in Table 3, the “1st view” of the mapping system was more defined in the sharp transition of axial-SpA and differed 3.5-5 times from the others. However, the progression of the observed structural disorders in the spine in this disease was characteristic of the extension of SpA and especially AS. In fact, table 3 shows that in the chronic course of the disease, the rate of occurrence of "1st appearance" was

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4.6%, and when it came to "7th view" it increased to 16.6%.

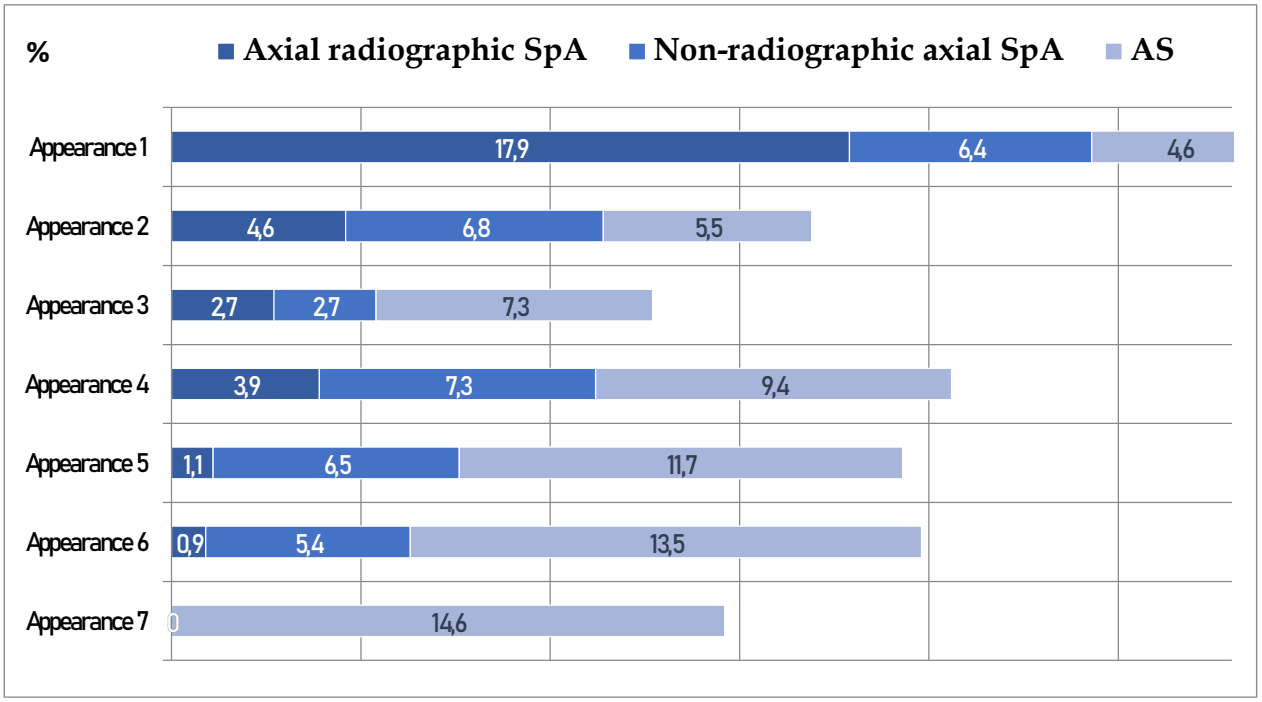

Table 3. Comparative analysis of the level of "mapping features" of spinal cord damage according to the clinical course of SpA.

Conclusion

Radiographic examinations play an important role in the diagnosis of ankylosing spondylitis and monitoring its development. Early identification and evaluation of changes in the structures of the spine and sacroiliac joints is crucial in preventing serious complications of the disease. The introduction of the mapping system allows for the standardization and systematic analysis of visualization results and helps to assess the dynamics of the disease. This approach allows doctors to develop individual treatment strategies and predict the development of the disease for each patient. It is important that future researches are focused on further expanding the scope of practical application of these methods.

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