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Differential diagnostics of musculoskeletal pain in spondyloarthrosis and osteoarthrosis using magnetic resonance imagraphy

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ABSTRACT

BACKGROUND: Musculoskeletal pain (MSP) has now become a non-infectious epidemic and is the second leading cause of disability, resulting in a significant loss of productivity among the able-bodied population in all industrialized countries. The main conditions most commonly encountered in outpatient appointments are spondyloarthritis (SA) of the lumbar spine and osteoarthritis (OA) of the knee. These diseases have similar pathogenesis and are accompanied by aseptic inflammation, involvement of muscules and ligaments, leading to the formation of various movement disorders, antinociceptive insufficiency, and peripheral and central sensitization. In this study, the results of magnetic resonance imaging (MRI) are presented, which can be used in early diagnosis of MSP, as well as dynamic control of treatment.

AIM: To evaluate neuroimaging signs in patients with SA and OA depending on the cause of the disease.

MATERIALS AND METHODS: Analytical one-stage study was performed with 158 patients with established clinical diagnosis of MSB, who were divided into four groups: primary knee OA (46 patients), posttraumatic OA (48 patients), spondylogenic OA (40 patients) and OA of 0–I stage (24 patients) To study neuroimaging signs the examination was performed on MRI devices Siemens Magnetom Aera 1.5T and General Electric Signa 1.5T.

RESULTS: MRI examination revealed stage III spondyloarthritis in 47.2% of patients, and stage II in 30.1%. Of the total number of patients, 33.3% had fragmentation of the inner and outer menisci of the knee joint, longitudinal damage of the inner meniscus was detected in 30.1% of cases and osteophytes of the knee joint in 30% of cases. Intervertebral disc sequestration (2.4%) and stage I spondyloarthrosis (7.3%) were the least common. When comparing the groups, more pronounced neuroimaging signs were detected in posttraumatic and primary OA, while they were significantly lower in spondylogenic genesis. No differences between the groups were found in the spine examination.

CONCLUSION: The study showed high informativeness of MRI in OA, which allows early diagnosis and differential diagnosis of the disease.

Keywords: musculoskeletal pain; spondyloarthritis; osteoarthritis; magnetic resonance imaging.

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Дифференциальная диагностика мышечно-скелетных болей при спондилоартрозе и остеоартрозе с использованием магнитно-резонансной томографии

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АННОТАЦИЯ

Обоснование. Мышечно-скелетная боль (МСБ) в настоящее время приняла характер неинфекционной эпидемии и занимает второе место среди причин инвалидности, приводя к существенной потере производительности среди трудоспособного населения во всех индустриально развитых странах. Основными заболеваниями, которые наиболее часто встречаются на амбулаторном приёме, являются спондилоартроз (СА) поясничного отдела позвоночника и остеоартроз (ОА) коленного сустава. Эти заболевания имеют сходный патогенез и сопровождаются асептическим воспалением, вовлечением в процесс мышечного и связочного аппарата, приводящим к формированию разнообразных двигательных нарушений, антиноцицептивной недостаточности, периферической и центральной сенситизации. В данном исследовании представлены результаты магнитно-резонансной томографии (МРТ), которые могут использоваться при ранней диагностике МСБ, а также динамического контроля в процессе лечения.

Цель. Оценка нейровизуализационных признаков у пациентов с СА и ОА в зависимости от генеза заболевания.

Материалы и методы. Выполнено аналитическое одномоментное исследование с участием 158 пациентов с установленным клиническим диагнозом МСБ, которые были разделены на четыре группы: первичный ОА коленного сустава (46 человек), посттравматический ОА (48 человек), спондилогенный ОА (40 человек) и ОА 0–I стадии (24 человека). Для изучения нейровизуализационных признаков обследование проводилось на аппаратах МРТ Siemens Magnetom Aera 1.5T и General Electric Signa 1.5T.

Результаты. При МРТ-обследовании у 47,2% пациентов выявили спондилоартроз III стадии, у 30,1% — II стадии. Из общего количества пациентов 33,3% имели повреждение в виде фрагментации внутреннего и наружного менисков коленного сустава, в 30,1% случаев выявили повреждение внутреннего мениска в виде продольного расщепления и в 30% случаев — остеофиты коленного сустава. Реже всего встречались секвестрация межпозвонкового диска — 2,4% и спондилоартроз I стадии — 7,3%. При сравнении в группах более выраженные нейровизуализационные признаки выявлялись при посттравматическом и первичном ОА, при спондилогенном генезе они были существенно ниже. При исследовании позвоночника различий в группах установлено не было.

Заключение. Исследование показало высокую информативность МРТ при ОА, позволяющую осуществлять раннюю диагностику и проводить дифференциальную диагностику заболевания.

Ключевые слова: мышечно-скелетная боль; спондилоартроз; остеоартроз; магнитно-резонансная томография.

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BACKGROUND

Currently, musculoskeletal pain (MSP) is a crucial medical and social problem, ranking second among the causes of disability according to the Centers for Disease Control and Prevention. It presents an economic burden for society owing to the increased risk of temporary or complete loss of working capacity and decreased labor productivity; in the USA, the annual costs of treating patients with MSP account for 9% of the total national costs [1, 2]. The most common causes of MSP are spondyloarthrosis (SA) and osteoarthritis (OA) of the knee joint [3, 4].

Spondyloarthrosis (OA of the facet joints of the spine) and gonarthrosis (OA of the knee joint) have a long progressive course. The disease affects the entire complex of joint and periarticular tissues, namely, the synovial membrane, articular cartilage, muscles, and ligamentous apparatus, resulting in the development of pain and impaired joint function and congruence. Notably, the main mechanism of disease development is chronic inflammation, leading to sensitization of nociceptors in the joint area. In SA, inflammation develops as a result of microtrauma of the muscular and ligamentous apparatus of the spine due to static and dynamic overloads, leading to locomotor disorders. Pain and sanogenetic hypertonicity play crucial roles in disease occurrence, which then contributes to the formation of myofascial trigger points. Moreover, OA is accompanied by the development of enthesopathy and inflammation of the synovial bursae, often involving the collateral ligaments and infrapatellar bursa. Furthermore, local damage to the ligamentous apparatus of the spine causes acute back pain in SA. Significant pathogenetic mechanisms leading to chronicity and a progressive disease course include degenerative–dystrophic changes and microcirculation disorders [5–9].

According to the International Classification of Diseases, 10th revision, OA is classified into primary, post-traumatic, secondary, and unspecified. Primary OA is largely due to hereditary predisposition caused by abnormalities in the formation of cartilaginous tissue of the joints that is, it is associated with risk factors. These risk factors include connective tissue dysplasia, sex, age, weight, mechanical overload, and inflammatory, metabolic, and endocrine diseases. [10–12]. Secondary OA is primarily associated with traumatic joint injury. It is often due to articular cartilage damage associated with meniscus injury [13]. Some studies distinguished spondylogenic OA, which is associated with degenerative changes in the spine, which leads to static and dynamic overloads of the knee joint [14–16].

The main imaging modality for SA and OA is radiography, which allows determining the severity of degenerative changes in the joint, assessment of the functional state of the ligamentous apparatus, and differential diagnostics [17, 18].

Moreover, many studies revealed a discrepancy between radiographic changes and the clinical presentation of SA and OA. Hannan et al. [19] studied 6880 patients aged 25–74 years. Among patients with stage II–IV knee OA, 47% complained of knee pain. A total of 1004 patients (14.6%) reported knee pain; only 15% of them had radiographic changes of stage II–IV OA. Furthermore, Zhou et al. [20, 21] showed the insufficient reliability of radiographic examination in SA. According to the Institute of Rheumatology of the Russian Academy of Medical Sciences [22], radiography does not allow direct visualization of the cartilage, of which thickness can only be determined indirectly by the width of the joint space. The authors point out false-positive and false-negative study results in 40% of those examined. Thus, radiolucent OA was identified, of which development remains controversial [23]. Pain in this variant of OA is believed to be sclerotomic in nature. In this study, the radiolucent type of OA was considered stage 0 knee OA, which emphasized the absence of radiographic signs, but with the presence of a characteristic clinical presentation.

In recent decades, magnetic resonance imaging (MRI) has been widely used to visualize SA and OA, allowing diagnosis of the early signs of the disease. The advantage of MRI is its high-contrast resolution, which enables the detection of even minor differences in soft tissue contrast and obtaining MRI images in any views, identifying various pathologies of the spine and joints, diagnosing degenerative disease of the joint and surrounding tissues, and assessing cartilage thickness [24–27].

This study aimed to evaluate neuroimaging signs in patients with SA and OA depending on the disease origin.

In addition, to radiographic and magnetic resonance staging of the severity of SA and OA, it is crucial to use a rehabilitation diagnosis according to the International Classification of Functioning (ICF). The ICF allows describing joint dysfunctions that have developed in a patient and is a tool for integrating assessment criteria when describing these dysfunctions [28]. It is a descriptive tool, and not a scale.

MATERIALS AND METHODS

Study design

An analytical cross-sectional study was conducted.

Eligibility criteria

The *inclusion criterion* was a diagnosis established at least 1 month before the start of the study.

The *exclusion criteria* were newly diagnosed SA and OA of the knee joint, other concomitant diseases and conditions that prevent the examination, and back and knee pain associated with other specific processes (e.g., cancer, infection).

Study conditions

The study was conducted at the Pirogov National Medical and Surgical Center from October 2023 to December 2023. The assessment included an initial clinical examination of the patient and MRI diagnostics, which was usually performed the following day.

This study was performed as part of medical diagnostic measures conducted in accordance with the standards for the provision of primary healthcare for OA of the knee joint and SA.

Study outcomes

Determination of the incidence of neuroimaging signs in knee OA of various origins.

Subgroup analysis

The criterion for distributing patients were divided into groups based on the origin of knee OA determined during clinical examination, namely, primary, post-traumatic, spondylogenic, and degree 0 osteoarthrosis of the knee joint.

Methods for recording outcomes

Each patient underwent a full clinical examination before neuroimaging, including palpation assessment of pain points in periarticular tissues and visual assessment of the range of motion in the knee joints and spinal configuration disorders, such as flattening of the lumbar lordosis, hyperlordosis, and scoliosis, to assess the current state of the lumbosacral spine and knee joints. All patients underwent MRI using Siemens Magnetom Aera 1.5T and General Electric Signa 1.5T in transverse, sagittal, and coronal views, according to T1W, T2W, and STIR with suppression of fat tissue in transverse, sagittal, and coronal views.

Ethical considerations

Voluntary informed consent was obtained from each examined patient with knee OA, which complies with the ethical standards of the Helsinki Declaration (2013).

Statistical analysis

The results were statistically analyzed using the Statistica 13.0 software package. When comparing several groups, the Kruskal–Wallis test was used. $P \leqslant 0.05$ indicated statistical significance. The Bayes method was used to calculate the probability of an event (MRI criterion).

RESULTS

Study participants

The study included 158 patients aged 37–72 years (mean age: 58.54 ± 8.36 years) who complained of pain in the knee joints and lumbosacral spine, including 53 men and 105 women (Table 1).

During the clinical examination, the anamnestic characteristics were clarified, namely, the presence of pain and its localization, starting pain, and gait disturbance (lameness). These indicated what preceded the occurrence of OA of the knee joint (e.g., physical activity, injury, and disease). The presence of hereditary factors, metabolic disorders (e.g., diabetes mellitus, gout, and obesity), and unfavorable factors, such as professional environment, uncomfortable postures, monotonous movements, and vibration, were clarified. The range of motion in the lumbar spine and knee joints was assessed, and the presence of painful points and spinal configuration disorders (i.e., flattening of the lumbar lordosis, hyperlordosis, and kyphosis) were detected. Based on the data obtained, primary, post-traumatic, and spondylogenic osteoarthrosis and osteoarthrosis of the knee joint stage 0 were determined (patients underwent X-ray examination of the knee joints no more than 6 months before the visit). This was used as basis for patient distribution.

To assess the function of the knee joints according to the ICF, we used tables for assessing pain associated with loading (Table 2), joint mobility during testing of the passive range of motion (Table 3), joint mobility during testing of the active range of motion (Table 4), and the ICF assessment of pain during palpation of periarticular tissues (Table 5), proposed by Prof. M.B. Tsykunov [28].

Table 1. Distribution of subjects by sex and age

Age	Male	Female	Total
37–48 years old	7	15	22
49–60 years old	14	27	41
61–72 years old	32	63	95
Total, *n* (%)	53 (33.5)	105 (66.5)	158 (100)

Table 2. Assessment of pain associated with loading according to ICF (b28015 pain in lower limb)

Sign characteristic	ICF assessment
No pain	0
Inconstant; mild pain is noted with heavy loads, which occurs periodically after excessively prolonged physical activity or physical activity in difficult conditions	1
Constantly noted with impaired stability of the joint or spine (sensation of displacement) and/or heavy and excessively prolonged loads on the joint and/or periodically intensifies with little physical activity and/or noted during walking long distance (more than 2 km)	2
Noted during prolonged walking and inconstantly with household loads	3
Noted during short-distance walking, constantly with household loads or constant severe pain	4

Table 3. Assessment of knee joint mobility according to ICF (b710) during passive movement testing (goniometry)

Sign characteristic	ICF assessment
Passive range of motion is not limited (96%–100% of normal)	0
Passive range of motion is slightly limited (50%–95% of normal)	1
Passive range of motion is moderately limited (25%–49% of normal)	2
Passive range of motion is severely limited (5%–24% of normal)	3
Passive range of motion is absent (0%–4% of normal) or ankylosis	4

Table 4. Assessment of knee joint mobility according to ICF (b710) during active movement testing (goniometry)

Sign characteristic	ICF assessment
Active range of motion is not limited (96%–100% of normal)	0
Active range of motion is slightly limited (50%–95% of normal)	1
Active range of motion moderately limited (25%–49% of normal)	2
Active range of motion is severely limited (5%–24% of normal)	3
Active range of motion is absent (0%–4% of normal) or ankylosis	4

Table 5. Pain on palpation of periarticular tissues according to ICF (b28015 pain in lower limb)

Sign characteristic	ICF assessment
No pain	0
Minor pain	1
Facial reaction	2
Limb withdrawal	3
Patient screams during palpation or does not allow the joint to be palpated	4

The MRI indicators were analyzed, and the main criteria for assessing neuroimaging disorders in the knee joint and spine were established depending on disease origin.

Research results

The predictive Bayesian approach provides basis for ensuring the quality of risk analysis and allows establishing probable relationships between the variables of interest. The approach considers that the risk cannot be adequately described and assessed simply by summing up probabilities [29, 30].

When analyzing the clinical examination data, which included the anamnestic characteristics of all the patients, each sign was represented by a logical variable with two possible values (1 or 0). The occurrence of the sign in each group was calculated as percentage (Table 6). Then, the

Table 6. Syndromes and risk factors in groups of patients with knee osteoarthritis, *n* (%)

Syndrome	Primary osteoarthritis (*n*=46)	Post-traumatic osteoarthritis (*n*=48)	Spondylogenic osteoarthritis (*n*=40)	Osteoarthritis deg. 0 (*n*=24)
Knee and spine pain	46 (100)	48 (100)	40 (100)	24 (100)
Painful points	43 (93.5)	47 (97.9)	40 (100)	23 (95.8)
Limited movement in the knee joint	45 (97.8)	45 (93.7)	37 (92.5)	21 (87.5)
Limited movement in the lumbar spine	38 (82.6)	32 (66.7)	40 (100)	15 (62.5)
Gait disturbance (lameness)	46 (100)	43 (89.6)	27 (67.5)	13 (54.2)
Violation of the spine configuration	41 (89.1)	38 (79.2)	39 (97.5)	20 (83.3)
Hereditary predisposition	41 (89.1)	26 (54.2)	33 (82.5)	11 (45.8)
Presence of injuries	25 (54.3)	47 (97.9)	23 (57.5)	7 (29.2)
Metabolic disorders	43 (93.5)	38 (79.2)	23 (57.5)	9 (37.5)
Physical and psychoemotional overload at work	38 (82.6)	40 (83.3)	35 (87.5)	17 (70.8)

decimal logarithms of the sign frequencies were obtained, which were considered as diagnostic coefficients. Afterward, the smallest value was subtracted from the values of the four sign coefficients, obtaining a zero value. By multiplying each coefficient by 10, the final diagnostic score was obtained (Table 7). The median values of the ICF assessments in patients with knee OA are presented in Table 8.

Clinical examination showed that gait disturbance (lameness) can be highly considered as a differential diagnosis in patients with primary and post-traumatic OA of the knee joint (Table 7). The maximum score in differential diagnostics is determined in the column "Limitation of motion in the lumbar spine" for spondylogenic and primary OA. Identifying provoking factors, such as metabolic disorders, are crucial for differential diagnosis; they have the maximum value in primary and post-traumatic OA, and injuries are more often detected in post-traumatic OA. Regarding hereditary predisposition, a higher score was revealed in primary and spondylogenic OA. However, it should be noted that the difference in most signs for differential diagnostics is insignificant, which explains the complexity of differential diagnostics of OA. The above necessitated a neuroimaging examination.

Diagnostic criteria of the MRI study consisted of qualitative and quantitative disorders. The qualitative signs were assessed according to the "presence–absence" principle; prevalence was calculated in each group. Group 4 was not included in the calculations (Table 9). Analysis of the final diagnostic scores (Table 10) showed that the maximum number of diagnostic scores was obtained in post-traumatic OA with signs of "incongruence of articular surfaces" and "partial inveterate rupture of the posterior cruciate ligament," whereas diagnostic scores were relatively high in cases of partial inveterate rupture of the anterior cruciate ligament. In primary OA, the diagnostic scores were lower and were more often high in cases wherein narrowing of the joint space and partial inveterate rupture of the posterior cruciate ligament were noted. In spondylogenic OA, the scores were higher in cases wherein disk sequestration and disk extrusion were observed. The remaining diagnostic scores were not of such significant importance for differential diagnostics.

Tables 11 and 12 present data obtained from a detailed group-by-group assessment of quantitative changes (the width of the joint space of the knee joint and facet joints of the lumbar spine). If a significant difference in the width of the joint space of the knee joint was obtained (p=0.0001), no

Table 7. Differential diagnostic scores in study groups

Syndrome	Primary osteoarthritis (n=46)	Post-traumatic osteoarthritis (n=48)	Spondylogenic osteoarthritis (n=40)	Osteoarthritis deg. 0 (n=24)
Knee and spine pain	0	0	0	0
Painful points	0.3	0.1	0.1	0
Limited movement in the knee joint	0.4	0.4	0.2	0
Limited movement in the lumbar spine	1.2	0.2	2	0
Gait disturbance (lameness)	2.8	2.3	1	0
Violation of the spine configuration	0.5	0	0.9	0.3
Hereditary predisposition	2.7	0.6	2.4	0
Presence of injuries	2.5	4.9	2.5	0
Metabolic disorders	4	3.3	1.8	0
Physical and psychoemotional overload at work	0.5	0.6	0.7	0

Table 8. Median values of ICF scores in patients with knee osteoarthritis of different origin, points

ICF assessment criteria	Primary osteoarthritis	Post-traumatic osteoarthritis	Spondylogenic osteoarthritis	Osteoarthritis deg. 0
Pain associated with loading	2	3	3	1
Passive range of motion	1	2	1	0
Active range of motion	1	3	1	0
Pain during palpation of periarticular tissues	2	3	3	1

Table 9. Diagnostic MRI criteria in groups of patients with knee osteoarthritis, *n* (%)

Criterion	Primary osteoarthritis (*n*=46)	Post-traumatic osteoarthritis (*n*=48)	Spondylogenic osteoarthritis (*n*=40)
Presence of high-intensity fluid	15 (32.6)	21 (43.7)	5 (12.5)
Partial inveterate rupture of the anterior cruciate ligament	12 (26)	35 (72.9)	3 (7.5)
Fragmentation of the medial and lateral meniscus	11 (23.9)	37 (77)	4 (10)
Longitudinal damage of the medial meniscus	19 (41.3)	44 (92.6)	17 (42.5)
Presence of osteophytes	17 (36.9)	40 (83.3)	4 (10)
Degenerative damage to cartilage tissue	20 (43.4)	20 (41.6)	5 (12.5)
Longitudinal damage of the lateral meniscus	7 (15.2)	12 (25)	8 (20)
Narrowing of the joint space to 1–2 mm	24 (52.1)	7 (14.5)	3 (7.5)
Incongruence of articular surfaces	4 (8.6)	41 (85.4)	1 (2.5)
Partial inveterate rupture of the posterior cruciate ligament	1 (2.1)	5 (10.4)	–
Spondyloarthrosis stage I	6 (13)	3 (6.2)	4 (10)
Spondyloarthrosis stage II	15 (32.6)	21 (43.7)	13 (32.5)
Spondyloarthrosis stage III	25 (54.3)	24 (50)	23 (57.5)
Disk protrusion	7 (15.2)	3 (6.2)	13 (32.5)
Disk extrusion	4 (8.6)	1 (2)	8 (20)
Disk sequestration	–	–	4 (10)

Table 10. Diagnostic scores of MRI changes in patients with knee osteoarthritis

Criterion	Primary osteoarthritis (*n*=46)	Post-traumatic osteoarthritis (*n*=48)	Spondylogenic osteoarthritis (*n*=40)
Presence of high-intensity fluid	4	6	0
Partial inveterate rupture of the anterior cruciate ligament	6	11	0
Fragmentation of the medial and lateral meniscus	3	9	0
Longitudinal damage of the medial meniscus	0	4	0
Presence of osteophytes	6	7	0
Degenerative damage to cartilage tissue	5	6	0
Longitudinal damage of the lateral meniscus	0	8	7
Narrowing of the joint space to 1–2 mm	7	2	0
Incongruence of articular surfaces	4	14	0
Partial inveterate rupture of the posterior cruciate ligament	7	4	0
Spondyloarthrosis stage I	3	0	3
Spondyloarthrosis stage II	2	3	4
Spondyloarthrosis stage III	0	0	1
Disk protrusion	3	0	6
Disk extrusion	5	0	9
Disk sequestration	0	0	10

Table 11. Joint space width in osteoarthritis and spondyloarthritis in groups

Group	Joint space of the knee joint	Joint space of the facet joint
Primary osteoarthritis (*n*=46)	3.43±0.28	1.10±0.04
Post-traumatic osteoarthritis (*n*=48)	5.16±0.30	1.09±0.05
Spondylogenic osteoarthritis (*n*=40)	5.51±0.32	1.11±0.08
Kruskal–Wallis test, *p*	0.0001	0.12

Table 12. Joint gap width of facet joints depending on the stage of spondyloarthritis

Stage of spondyloarthrosis	Joint cavity of facet joint	Kruskal–Wallis test, *p*
I	1.73±0.6	
II	1.38±0.02	0.0001
III	0.86±0.03	

significant differences were noted when measuring the facet joints ($p = 0.12$). However, a significant difference ($p = 0.0001$) was found in the width of the joint space of the facet joints depending on the stage of SA.

Measurement of the sizes of the collateral ligaments conducted during the study is of particular interest. The length of the lateral ligament ranged from 5.45 cm to 6.30 cm, and the transverse size ranged from 0.43 cm to 0.74 cm in diameter. Furthermore, the length of the medial collateral ligament ranged from 4.47 cm to 5.10 cm, and the transverse size was from 0.40 cm to 0.53 cm in diameter.

Adverse events

No adverse events were noted during the study.

DISCUSSION

Summary of the main results of the study

The study confirmed neuroimaging signs in patients with SA and OA of the knee joint, depending on the disease pathogenesis, some of which, such as the presence of bone growths in the form of osteophytes, degenerative changes in cartilage tissue in the form of a violation of its integrity, the presence of high-intensity fluid, MRI signs of SA, protrusions, extrusions, and sequestration of the disk, have been described in the literature. Additionally, the diagnostic scores for the main signs of the disease in groups were calculated, and the sizes of the joint space of the knee joint and facet joints were determined, as well as the sizes of the joint space of the facet joints, depending on the stage of SA.

Discussion of the main result of the study

Study results demonstrate that disease development is influenced by various factors. Similarities in pathogenesis between different diseases causes certain difficulties for clinicians in differential diagnostics.

MRI is a relatively informative modality for establishing the pathological process in the knee and facet joints. However, information in the literature on the use of neuroimaging studies in OA of various origins is insufficient. The pathogenesis of stage 0 knee OA remains controversial. Notably, the disease is characterized by sclerotomic spread of pain due to mechanical action in the ligaments, tendons, and periosteum at the level of L_{III}–L_{IV} [31, 32].

Study limitations

This study did not conduct a neuroorthopedic examination of patients (i.e., goniometry, tensoalgometry, and scoliosometry), which may have its own characteristics in people with musculoskeletal pain. The analysis focused on neuroimaging changes that affect locomotor disorders.

CONCLUSION

Neuroimaging examination is the most informative method for diagnosing injuries and degenerative changes in the knee joint. The developed criteria can be used in practical work for diagnostics, which enables assessment of the severity of knee joint damage in OA. The developed scoring system for diagnostics allows differential diagnostics of various types of knee OA.

ADDITIONAL INFO

Autor contribution. All authors confirm that their authorship meets the international ICMJE criteria (all authors have made a significant contribution to the development of the concept, research and preparation of the article, read and approved the final version before publication). The greatest contribution is distributed as follows: Yu.O. Novikov — study design development, analysis of literature sources, analysis of obtained data, writing and editing the text of the article; A.A. Bogachev — literature review, collection and analysis of literature sources, clinical testing of subjects, analysis of obtained data, writing and editing the text of the article; M.B. Tsykunov — study design development, analysis of literature sources, analysis of obtained data, writing and editing the text of the article.

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ДОПОЛНИТЕЛЬНО

Вклад авторов. Все авторы подтверждают соответствие своего авторства международным критериям ICMJE (все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией). Наибольший вклад распределён следующим образом: Ю.О. Новиков — разработка дизайна исследования, анализ литературных источников, анализ полученных данных, написание и редактирование текста статьи; А.А. Богачёв — обзор литературы, сбор и анализ литературных источников, проведение клинического тестирования испытуемых, анализ полученных

данных, написание и редактирование текста статьи; М.Б. Цыкунов — разработка дизайна исследования, анализ литературных источников, анализ полученных данных, написание и редактирование текста статьи.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования и подготовке публикации.

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