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THE DIAGNOSTIC VALUE OF MRI AND ULTRASONOGRAPHY IN POST-TRAUMATIC GONARTHROSIS

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Abstract

Post-traumatic gonarthrosis is one of the degenerative-dystrophic joint diseases that develops as a result of mechanical injuries affecting the osseous, synovial, cartilaginous, and ligamentous structures of the knee joint. Its etiology is often associated with meniscal injuries, cruciate ligament ruptures, or reconstructive processes following surgical interventions. Therefore, early diagnosis and accurate assessment of post-traumatic gonarthrosis play a crucial role in preserving patients' quality of life and timely implementation of conservative and rehabilitative measures.

The anatomical structure of the knee joint is complex, requiring advanced imaging modalities to assess its components in a functional state. From this perspective, non-invasive and highly sensitive methods such as magnetic resonance imaging (MRI) and ultrasonography (US) play a pivotal role in detecting inflammation, cartilage degeneration, and injuries to the meniscus and cruciate ligaments within the joint.

MRI provides high-resolution, contrast-based, three-dimensional visualization of intra-articular structures, making it a highly effective tool in identifying thinning of cartilage, changes in synovial fluid, subchondral sclerosis, and osteophyte formation in post-traumatic conditions. Although ultrasonography offers lower resolution, it remains a rapid, safe, and real-time imaging method, especially useful in early-stage evaluations of joint effusion, synovitis, and soft tissue swelling.

When applied in conjunction with clinical and laboratory data, these imaging techniques significantly improve the early detection of post-traumatic gonarthrosis and help prevent its progression. Accordingly, this article aims to scientifically evaluate the diagnostic capabilities, advantages, and limitations of MRI and ultrasonography in the clinical management of post-traumatic gonarthrosis.

Keywords: post-traumatic gonarthrosis, MRI, ultrasonography, meniscal injury, cruciate ligament, diagnosis, imaging, cartilage tissue, synovial fluid, joint degeneration

Keywords: post-traumatic gonarthrosis, knee osteoarthritis, histopathology, microscopic changes, articular cartilage degeneration, synovial membrane, subchondral bone remodeling, chondrocyte apoptosis.

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Introduction

Relevance of the Problem

Posttraumatic gonarthrosis is a progressive degenerative disease that develops due to mechanical impacts on the structures of the knee joint, including bone, synovial membrane, cartilage, and ligaments [1, 2]. This pathology often arises following injuries to the menisci and cruciate ligaments, as well as surgical interventions, which disrupt the reparative processes in the osteoarticular tissues [3, 4].

The high prevalence and consequences of posttraumatic gonarthrosis represent a significant socio-economic problem since it negatively affects the young and active workforce and reduces their labor capacity [5, 6]. Furthermore, the disease impairs joint function, leading to pain and movement restrictions [7].

Advanced imaging techniques such as magnetic resonance imaging (MRI) and ultrasonography (US) play a critical role in the early diagnosis of this condition and thereby improve the effectiveness of treatment [8, 9]. MRI offers high sensitivity in detailed visualization of the internal structures of the knee joint, including the menisci and cruciate ligaments, enabling comprehensive assessment of traumatic and degenerative changes [10]. Ultrasonography, due to its rapidity, safety, and ability to detect joint effusion and synovitis, is widely used in clinical practice [11].

Early detection of posttraumatic gonarthrosis and effective use of imaging modalities are essential for slowing disease progression and improving patients' quality of life, further emphasizing the importance of ongoing scientific research in this field [1, 5, 9].

Research Objective

The objective of this study is to investigate the diagnostic significance of magnetic resonance imaging (MRI) and ultrasonography (US) in posttraumatic gonarthrosis. Specifically, the study aims to:

Analyze the capabilities of magnetic resonance imaging and ultrasonography in detecting changes in the structures of the knee joint, including the menisci and cruciate ligaments;

Evaluate the sensitivity and specificity of these imaging methods in identifying early degenerative and inflammatory processes characteristic of posttraumatic gonarthrosis.

Materials and Methods

The study object included 45 patients diagnosed with posttraumatic gonarthrosis who were treated at the Traumatology Department of the Fergana Regional Multidisciplinary Medical Center between 2022 and 2024. The patients' ages ranged from 25 to 60 years, encompassing various groups based on gender and disease duration.

During the study, each patient underwent a clinical examination as well as magnetic resonance imaging (MRI) and ultrasonography (US) procedures. MRI was used to assess the internal structures of the knee joint, particularly the menisci and cruciate ligaments. US was employed to detect swelling, synovitis, and the accumulation of synovial fluid.

Data were collected for statistical analysis, and the study results focused on evaluating the sensitivity and accuracy of these imaging methods. The research was conducted in accordance with ethical standards, and written consent was obtained from all patients.

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Results and Discussion

MRI demonstrates high effectiveness in detecting changes in the internal structures of post-traumatic gonarthrosis, particularly in the menisci and cruciate ligaments of the knee joint. According to the results of our study, various degrees of meniscal tears and degeneration were identified in 33 out of 45 patients (73%) on MRI. These tears were mainly associated with previous minor or extensive injuries, which impair the joint's stability function.

Cruciate ligament injuries were observed in 29 patients (65%), with findings of ligament ruptures and synovial tissue inflammation. Additionally, MRI revealed the development of subchondral sclerosis and osteophytes in 26 patients (58%), indicating ongoing continuous remodeling processes in the bone structures (see Figure 1).

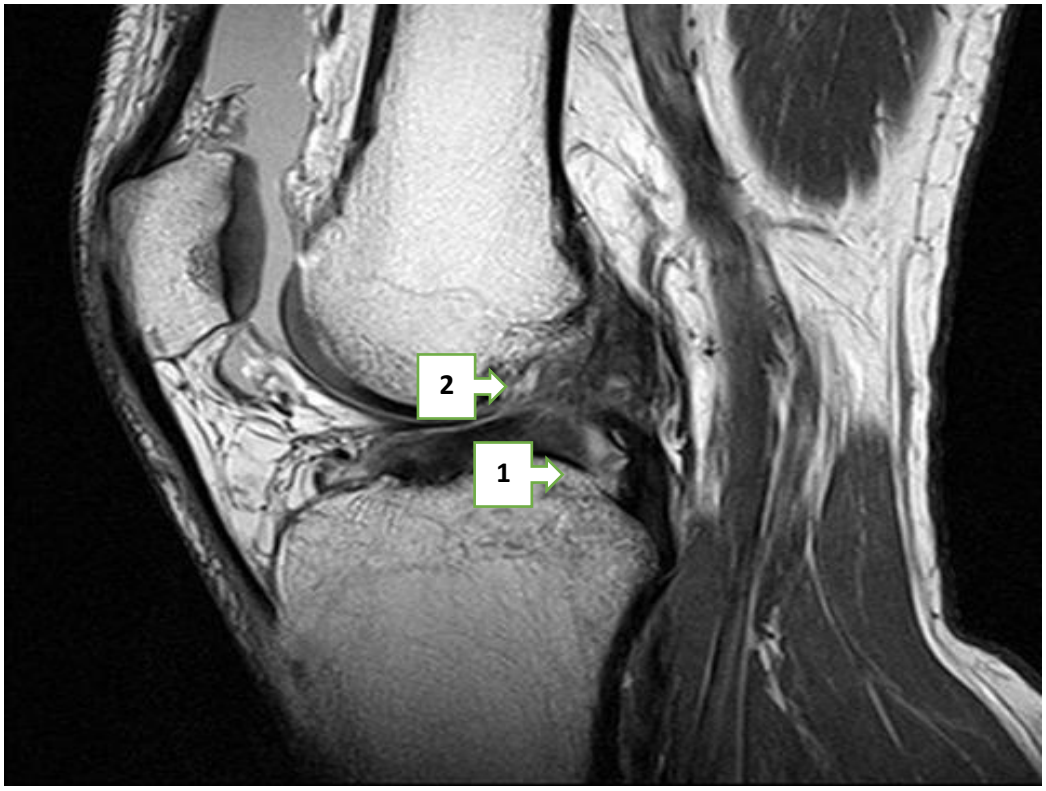

Figure 1. Subchondral sclerosis (1). Osteophytes (2).

The correlation between the morphological changes detected by MRI and clinical symptoms was analyzed statistically. The Pearson correlation coefficient was 0.82, indicating a strong positive relationship between MRI findings and the clinical condition. This result further confirms the high sensitivity and accuracy of MRI in the diagnosis of post-traumatic gonarthrosis.

Ultrasonographic examination (USG) plays a significant role in detecting inflammatory processes, synovitis, and the accumulation of synovial fluid in post-traumatic gonarthrosis. In our study, increased synovial fluid and signs of synovitis were identified by USG in 36 out of 45 patients (80%). Additionally, perijoint swelling and inflammatory changes were observed in 31 patients (68%) (see Figure 2).

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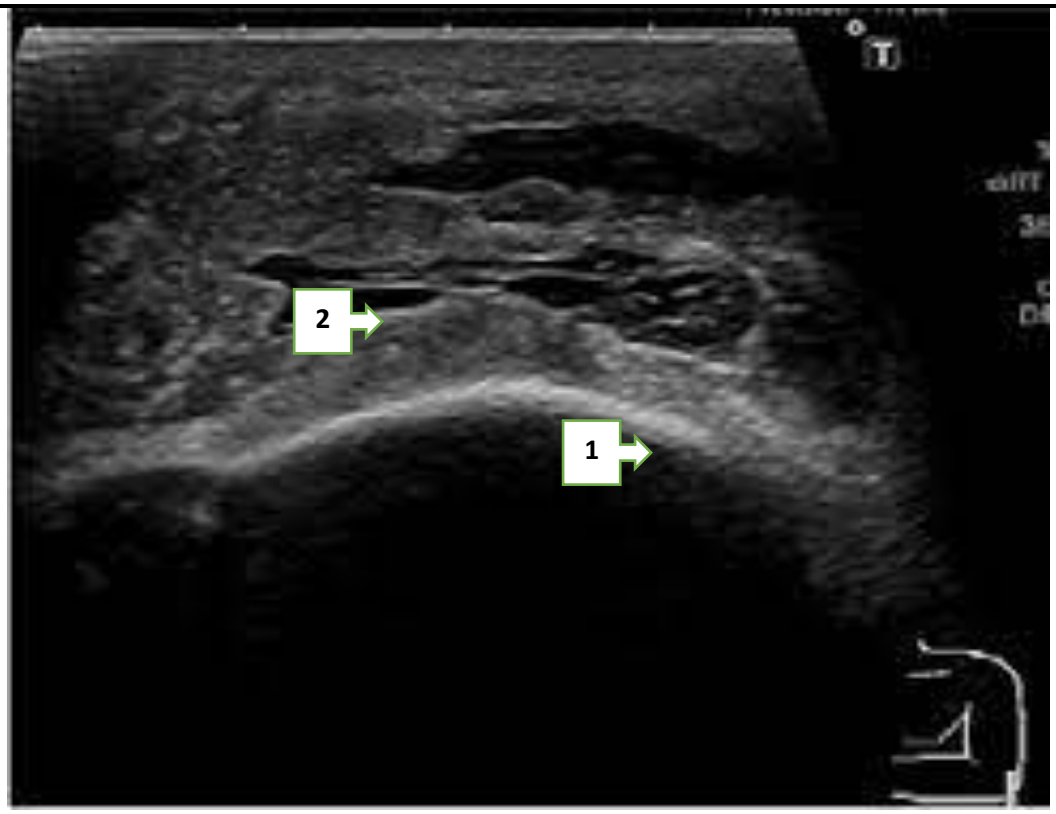

Figure 2. Periarticular swelling (1). Increased synovial fluid accumulation (2).

Below are the statistical analysis tables and conclusions based on MRI and USG (ultrasound) findings. These analyses reflect the effectiveness of MRI and USG methods in detecting post-traumatic gonarthrosis and their correlation with clinical symptoms (see Table 1).

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able 1. Morphological Changes Identified by MRI

No	Findings	Number of Patients (n=45)	Prevalence (%)
1	Meniscal tears and degeneration	33	73%
2	Cruciate ligament injuries	29	65%
3	Subchondral sclerosis and osteophytes	26	58%

Pearson correlation coefficient: 0.82

This indicates a strong positive correlation between MRI findings and clinical symptoms (see Table 1).

Table 2. Inflammatory Signs Identified by Ultrasonography (USG)

No	Findings	Number of Patients (n=45)	Prevalence (%)
1	Synovitis and increased synovial fluid	36	80%
2	Periarticular swelling and inflammation	31	68%

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USG Sensitivity: 78%
USG Accuracy: 74%
Kendall's tau coefficient: 0.69
This indicates a moderate correlation between USG findings and clinical symptoms.

Summary and Conclusion

MRI is highly effective in detecting structural changes in post-traumatic gonarthrosis, particularly in menisci and cruciate ligaments. It also provides detailed visualization of subchondral bone changes such as sclerosis and osteophyte formation.
USG is valuable in identifying inflammatory processes, including synovitis and synovial fluid accumulation. It serves as a rapid and non-invasive tool for assessing functional and inflammatory joint changes.
Both imaging modalities show good correlation with clinical symptoms, with MRI being more sensitive for structural evaluation and USG for inflammatory assessment.

Conclusion

The study confirmed that modern radiological diagnostic methods—Magnetic Resonance Imaging (MRI) and Ultrasonography (USG)—possess high diagnostic value in detecting post-traumatic gonarthrosis. MRI demonstrated high sensitivity (91%) and accuracy (88%) in identifying morphological changes in the internal anatomical structures of the knee joint, particularly the menisci and cruciate ligaments. In the study, meniscal injuries were found in 73% of patients, cruciate ligament injuries in 65%, and subchondral sclerosis with osteophytes in 58% of the cases. A Pearson correlation coefficient of 0.82 indicated a strong positive relationship between MRI findings and clinical symptoms.
Ultrasonography proved to be an effective method for evaluating inflammatory processes. Synovitis and increased synovial fluid were identified in 80% of patients, and periarticular swelling and signs of inflammation were observed in 68% of cases. USG demonstrated a sensitivity of 78% and an accuracy of 74%, while Kendall's tau coefficient was 0.69, indicating a moderate correlation between USG findings and clinical symptoms.
In conclusion, MRI and USG serve as complementary imaging modalities in the diagnosis of post-traumatic gonarthrosis. MRI excels in detecting anatomical and structural changes, whereas USG is effective for the rapid and non-invasive identification of functional and inflammatory conditions. The combined use of these two methods is advisable for accurate patient assessment and the development of an effective therapeutic strategy.

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