

## ENHANCING RADIOLOGICAL METHODS FOR THE DETECTION AND EVALUATION OF LATE-ONSET HIP JOINT COMPLICATIONS FOLLOWING COVID-19 INFECTION

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**Relevance:** Severe coronavirus disease 2019 (COVID-19) may present with a broad spectrum of extrapulmonary manifestations and lead to persistent, long-term effects collectively referred to as post-COVID syndrome (PCS). At present, there is no universally accepted definition or standardized terminology for PCS; however, the term is widely used in scientific literature. In the autumn of 2021, the World Health Organization (WHO) proposed a definition of the post-COVID-19 condition, describing it as a set of symptoms that typically develop approximately three months after the onset of COVID-19, persist for at least two months, and cannot be explained by alternative diagnoses. As a result, clinicians across all medical specialties increasingly encounter the consequences of this syndrome. Musculoskeletal manifestations are common, with arthralgia reported in approximately 19% of patients with PCS (Lopez-Leon S., 2021).

**Purpose:** Improving the effectiveness of radiation diagnosis of late post-covid pathologies of the hip joint and identification of specific radiological semiotics of those pathologies.

**Methods and techniques:** The analysis of patient data performed in 150 individuals: the control group consisted of 50 healthy and the main group of 100 patients, who in turn examined using X-ray examination, ultrasound, MRI and CT methods. All examinations of patients were conducted on the basis of the Radiology Department of the Andijan Regional Hospital of Traumatology and Orthopedics.

**Results:** Among patients with a documented history of COVID-19 who were included in the study, pathological complications involving the hip joint were identified in 100% of cases. All obtained imaging findings were systematically compared with data from a control group of patients without prior COVID-19 infection. The comparative analysis demonstrated that multislice computed tomography (MSCT) offers several significant advantages over conventional radiography. In particular, MSCT made it possible to detect pathological changes in the femoral head beginning from the second stage of aseptic necrosis, which are often not visualized on standard X-ray images. However, the principal limitation of MSCT remains the relatively high radiation exposure to the patient.

As a complementary imaging modality, magnetic resonance imaging (MRI) was used as a secondary diagnostic method. MRI enables direct and detailed visualization of the synovial membrane, articular cartilage, fibrocartilaginous structures, bone tissue, and paraosseous soft tissues. In addition, MRI provides advanced morphological tissue characterization and superior contrast resolution due to differences in signal intensity across various imaging sequences. A key advantage of MRI is the complete absence of ionizing radiation, making it particularly valuable for repeated examinations. Compared with other radiological techniques, MRI allowed the most accurate assessment of the stage of the pathological process, detection of bone marrow edema, and identification of intra-articular effusion that remains invisible on conventional radiographs.

Ultrasonography, as a non-invasive, accessible, and safe diagnostic method, allows assessment of both soft tissue and bone-adjacent structures. Furthermore, it enables evaluation of blood flow in the vessels supplying the femoral head using Doppler techniques and permits the application of contrast-enhanced methods to improve visualization. Nevertheless, despite these

advantages, ultrasound remains less informative in the diagnosis of osteonecrosis due to limited knowledge of specific ultrasonographic features and insufficient ability to accurately determine the extent and severity of femoral head involvement in aseptic necrosis. In all patients with a previous history of COVID-19 included in the present study, pathological changes of the hip joint were detected, accounting for 100% incidence within the examined cohort. The imaging results obtained were subsequently compared with those of a control group. This comparative evaluation revealed that multislice computed tomography (MSCT) significantly outperforms conventional radiography in diagnostic sensitivity. Specifically, MSCT enabled early identification of structural alterations in the femoral head starting from the second stage of aseptic necrosis, which frequently remain undetected on plain radiographs. Despite its high diagnostic value, the major drawback of MSCT is the increased radiation burden, which limits its widespread or repeated use, especially in younger patients.

As an alternative and complementary diagnostic tool, magnetic resonance imaging (MRI) was employed. MRI offers comprehensive visualization of intra-articular and periarticular structures, including the synovial lining, hyaline and fibrous cartilage, osseous components, and surrounding soft tissues. Moreover, MRI provides the ability to assess tissue morphology and composition based on differences in signal characteristics across multiple imaging sequences. One of the most important benefits of MRI is the absence of radiation exposure, which significantly enhances patient safety. Compared with other imaging modalities, MRI demonstrated the highest accuracy in staging the pathological process, detecting bone marrow involvement, identifying early ischemic changes, and revealing joint effusion that cannot be visualized on radiographic examinations.

Ultrasonography represents a widely available, non-invasive, and cost-effective diagnostic method that allows evaluation of soft tissue structures and adjacent bone surfaces. In addition, Doppler ultrasound facilitates assessment of blood flow in the feeding vessels of the femoral head, while contrast-enhanced ultrasound techniques may further improve image quality. Nevertheless, despite these advantages, the diagnostic value of ultrasound in osteonecrosis remains limited. This limitation is primarily related to insufficient characterization of ultrasonographic features of aseptic necrosis and the difficulty in accurately determining the depth, extent, and stage of femoral head involvement.

**Conclusions:** The findings presented above underscore the high clinical relevance of the broad implementation of ultrasound and magnetic resonance imaging in the comprehensive evaluation of structural pathological changes associated with post-COVID osteoarthritis of the hip joint at all stages of disease progression. Given the elevated risk of functional impairment and disability in patients with post-COVID syndrome (PCS), timely and accurate imaging assessment is of particular importance.

A crucial aspect of improving diagnostic accuracy lies in the more in-depth investigation of the capabilities of these imaging modalities in differentiating various forms of osteoarthritis and aseptic necrosis of the hip joint during the post-COVID period. This includes precise staging of the pathological process, early detection of ischemic and degenerative changes, and assessment of the extent of joint involvement. The application of contrast-enhanced imaging techniques further expands diagnostic potential by improving visualization of vascular alterations and soft tissue structures.

In addition, the development and implementation of optimized, standardized radiological algorithms integrating ultrasound and MRI are essential for the rational and efficient examination of hip joints in post-COVID patients. Such an approach may contribute to earlier diagnosis, improved monitoring of disease progression, and more informed clinical decision-making, ultimately reducing the risk of long-term disability and improving patient outcomes.

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