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CASE REPORT

Map-Like Magnetic Resonance Imaging Changes in HIV-Positive Patient with Multiple Osteonecrosis: A Case Report

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Background: Osteonecrosis is a common complication, particularly in HIV-infected patients undergoing long-term glucocorticoid therapy. This case report aims to highlight the unique "map-like" magnetic resonance imaging (MRI) changes observed in an HIV-positive patient with multiple osteonecrosis due to glucocorticoid overdose, emphasizing the importance of recognizing and managing this complication in this high-risk population.

Case Presentation: A 29-year-old HIV-positive male patient developed extensive multi-joint osteonecrosis involving 7 joint sites (right shoulder, bilateral hips, bilateral knees, and bilateral ankles) after 6 months of high-dose glucocorticoid treatment for an opportunistic pneumonia associated with his HIV status. The patient required prolonged glucocorticoid therapy to manage the severe lung infection. MRI revealed characteristic "map-like" changes, with the osteonecrotic areas distributed in a linear, clustered, or map-like pattern. To alleviate his condition and improve joint function, the patient underwent a customized treatment plan, including total hip replacement for the left hip, core decompression surgery for the right hip. Following surgical intervention, the patient experienced reduced joint pain and improved joint mobility.

Conclusion: This case underscores the potential risk of extensive multi-joint osteonecrosis in HIV-positive patients receiving long-term high-dose glucocorticoids, with the "map-like" MRI changes being a distinctive imaging feature. It emphasizes the importance of close monitoring and timely implementation of effective interventions in this high-risk population. Notably, core decompression surgery can improve local blood circulation, slow disease progression, and serve as an effective minimally invasive treatment option for early-stage osteonecrotic lesions.

Keywords: HIV, MRI, "map-like"changes, osteonecrosis, multiple sites, case report

Introduction

Osteonecrosis, also known as avascular necrosis, is the death of bone cells due to impaired blood supply, leading to structural collapse of bone tissue.[1] It frequently affects bones with precarious blood supply, such as the femoral head and humeral head.[2] Causes include trauma, corticosteroid use, excessive alcohol consumption, and autoimmune disorders.[3,4] Osteonecrosis is a recognized complication among people living with HIV (PLWH), particularly those on long-term glucocorticoid therapy for managing opportunistic infections or other HIV-related conditions.[5,6] The risk in this population is higher compared to the general population, with incidence rates from 3% to 20%,[7,8] due to the combined effects of HIV, antiretroviral therapy, and prolonged glucocorticoid exposure.[9,10] Early diagnosis is crucial to prevent further bone collapse and joint destruction. MRI is the preferred imaging modality, typically showing decreased signal intensity on T1-weighted images and increased signal intensity on T2-weighted images, indicating bone marrow edema and necrosis.[11,12] Occasionally, atypical imaging patterns, such as "map-like" changes, are observed. Timely diagnosis and management are essential to alleviate symptoms and preserve joint function. Core decompression surgery, a minimally invasive procedure that improves local blood circulation, is effective for early-stage osteonecrotic lesions.[13] Previous

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literature has reported osteonecrosis in HIV patients[9,14,15], but cases involving multiple periarticular sites are rare. This case report presents an HIV-positive patient with extensive multi-joint osteonecrosis involving seven joint sites after high-dose glucocorticoid therapy for an opportunistic lung infection. Admitted to the Orthopedics Department of Beijing Ditan Hospital on November 30, 2023, the patient's MRI revealed unique "map-like" patterns, rarely described in literature. This report discusses the clinical presentation, imaging findings, and customized treatment approach for this challenging condition.

Case Presentation

A 29-year-old unmarried Han Chinese male patient, with a height of 180 cm, weight of 72 kg, and BMI of 22.2 kg/m2, was admitted to the hospital due to pain and limited movement in both hips, left knee, and right shoulder for 7 months. Notably, the patient had received prednisone at a dose of 15 mg for 6 months, totaling 2250 mg, for the treatment of severe pneumonia, a common opportunistic infection in HIV-positive individuals. Figure 1 shows the patient's past medical history, consultation process and management measures.

Upon admission, laboratory tests revealed an HIV viral load of <20 copies/mL, CD4+ T lymphocyte count of 962 cells/μL, CD8+ T lymphocyte count of 867 cells/μL with a ratio of 0.9, ESR of 43.5 mm/h, CRP of 18.9 mg/L, and vitamin D deficiency with 25(OH)D level of 7.5 ng/L. Bone mineral density scans showed osteoporosis in the lumbar spine, bone loss in the femoral neck, and normal bone quality in the total hip. Imaging studies demonstrated osteonecrosis in the right shoulder, right hip, left knee, and bilateral ankle joints (As is shown in Figure 2). Physical examination

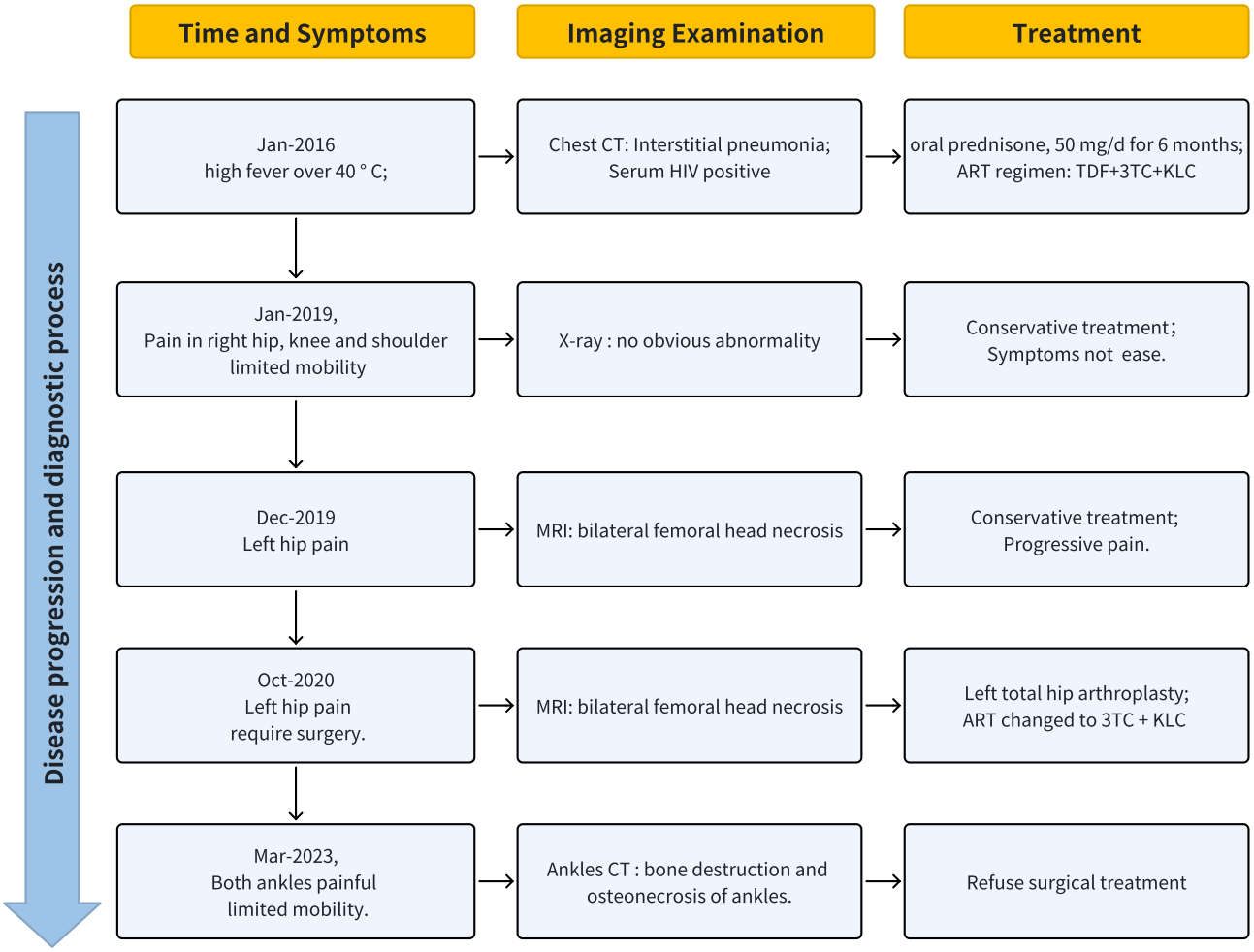

Figure 1 Flowchart of disease progression, diagnosis and treatment of this patient.

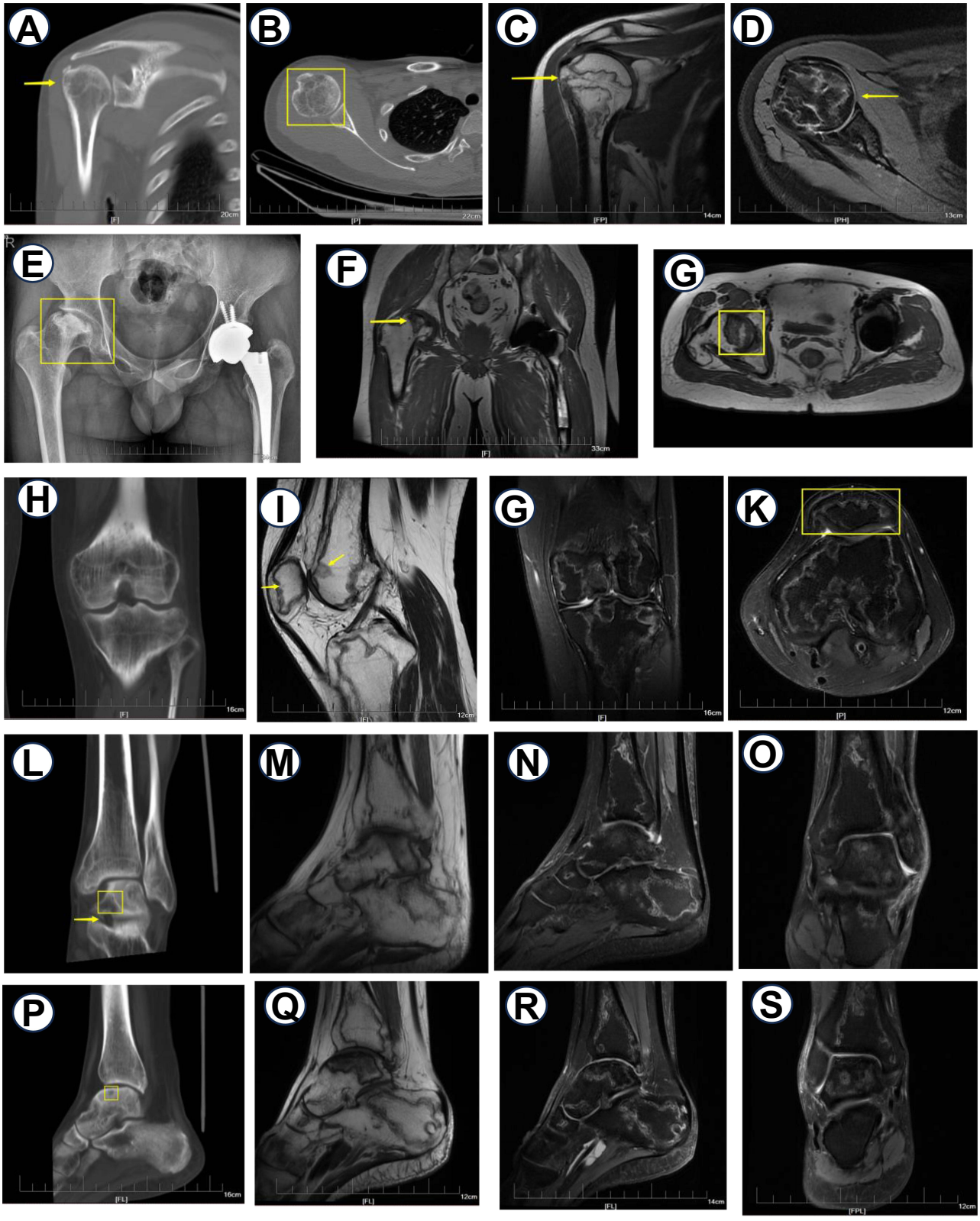

Figure 2 Imaging examination results of the right shoulder joint, bilateral Hip joint, left knee joint, and bilateral ankle joint. The typical lesion area is marked with yellow arrows and boxes. (**A** and **B**) CT: speckled dense shadow is seen on the outer edge of the right human tuberosity (**C** and **D**) MRI: T1WI shown low signal, and multiple patches and line like changes were seen; T2WI showed high signal, and geographic map like changes were seen; (**E**) X-ray: the right femoral head collapsed; (**F** and **G**) MRI: the right femoral head is collapsed; T1WI shows low signal, and multiple patches and line-like changes can be seen; T2WI and FS-PD show high signal, and map-like changes can be seen; (**H**) X-ray: hypodense shadow around the lower end of the femur and tibial joint on the left side. (**I–K**) MRI: bone signal abnormality can be seen in the left distal femur and proximal tibiofibula; (**L**) X-ray: hypodense shadow under the articular surface of the right talus. (**M–O**) MRI: bone signal abnormality was seen in the right distal tibia, distal fibula and multiple tarsal bones. (**P**) X-ray: hypodense shadow under the articular surface of the left talus. (**Q–S**) MRI: Bone signal abnormalities are seen in the right distal tibia, distal fibula, and multiple tarsals.

Table 1 Comparison of Actual and Postoperative Joint Ranges of Motion of the Right Shoulder, Right Hip, Both Knees and Both Ankles

Painful joint	Joint movements	Preoperative	Two weeks after surgery	Normal
Shoulder joint (right)	Forward flexion and extension	45°~ 0°~ 10°	45°~ 0°~ 10°	90 °and 45°
	Abduction and adduction	25°~ 0°~ 15°	25°~ 0°~ 15°	20°~40°and 90°
	Internal and external rotation	65°~ 0°~ 25°	65°~ 0°~ 25°	80°and 30°
	Lift up	——	——	90°
Hip joint (right)	Forward flexion and extension	15°~ 0°~ 10°	25°~ 0°~ 15°	145 °and 40°
	Abduction and adduction	5°~ 0°~ 5°	10°~ 0°~ 10°	20°~30°and 30°~45°
	Internal and external rotation	0°~ 0°~ 5°	10°~ 0°~ 15°	40°~50°and 40°~50°
Knee joint (left)	Knee flexion	30°~ 85°	0°~ 120°	145°
	Knee extension	5°	5°	10°~15°
Ankle (left / right)	Dorsi-flexion	10°/ 10°	15°/ 20°	20°~30°
	Plantar flexion	35°/ 30°	35°/ 35°	40°~50°
	Varus	—— / ——	20°/ 20°	30°
	Eversion	—— / ——	15°/ 15°	30°~35°

revealed an antalgic gait, right shoulder drooping by approximately 3 cm, tenderness, mild swelling, and significant limitation of movement in the right shoulder, right hip, left knee, and bilateral ankle joints. Preoperative joint mobility ranges are presented in Table 1. The patient was diagnosed with HIV infection, right shoulder osteonecrosis, status post-right total hip replacement, left femoral head osteonecrosis, left knee bone infarction, bilateral ankle osteonecrosis, hyperlipidemia, hypertension, vitamin D deficiency, hypophosphatemia, and osteoporosis.

On December 1, 2023, the patient underwent core decompression surgery of the right femoral head under spinal anesthesia. Routine prophylactic antibiotics were administered preoperatively, and antibiotics were discontinued 3 days after surgery. The sutures were removed, and the patient was discharged on the 14th postoperative day without any significant surgical site infection or complications. Postoperatively, the patient experienced reduced pain and improved range of joint motion, as detailed in Table 1.

Discussion

This case report presents a 29-year-old HIV-positive male who developed extensive multi-joint osteonecrosis following six months of high-dose glucocorticoid therapy for opportunistic pneumonia. The distinct "map-like" magnetic resonance imaging (MRI) changes observed in this patient highlight a rare but significant complication in HIV-infected individuals undergoing prolonged glucocorticoid treatment. The findings underscore the need for heightened vigilance and prompt intervention in this vulnerable population to mitigate the severe impacts of osteonecrosis on patient quality of life. The "map-like" MRI changes observed in this patient are a unique imaging finding that may provide valuable insights into the pathophysiology and progression of HIV-associated osteonecrosis. Recognizing these imaging patterns can aid in the early diagnosis and appropriate management of this complication in HIV-positive patients receiving long-term glucocorticoid therapy.

Osteonecrosis is a recognized complication in HIV-positive patients, particularly those receiving long-term corticosteroid therapy. Previous studies have documented cases of osteonecrosis in this population, often involving major joints such as the hips, knees, and shoulders.[6,16,17] However, the unique "map-like" MRI changes observed in our patient have not been widely reported in the literature. Most documented cases describe more diffuse or localized patterns of

osteonecrosis, typically presenting as focal lesions or areas of bone marrow edema on MRI.[16] The distinctive linear, clustered distribution of osteonecrotic areas seen in our patient suggests a potentially different pathophysiological process, which could be related to the specific effects of glucocorticoids in the presence of HIV infection.[18] Notably, the newest study by Migliorini F et al (2024) has reported similar complications in patients receiving corticosteroids for severe conditions, such as COVID-19, where avascular necrosis has been observed following high-dose corticosteroid therapy.[19] This highlights the broader implications of corticosteroid-induced osteonecrosis beyond HIV-infected individuals and underscores the necessity of vigilant monitoring and early intervention to mitigate this risk.

HIV-associated immune dysregulation, chronic inflammation, and metabolic disturbances may contribute to altered bone metabolism and microvascular compromise, predisposing these patients to osteonecrosis.[20,21] The "map-like" pattern may reflect a unique interaction between HIV infection, immunosuppressive treatment, and vascular health, leading to this distinct presentation. Moreover, the extensive multi-joint involvement in our patient, affecting seven joint sites, is relatively uncommon in the literature, with most reported cases describing osteonecrosis limited to one or two major joint sites.[9,22,23] This widespread involvement could be indicative of a more severe or rapidly progressive form of the disease, potentially exacerbated by the high-dose and prolonged glucocorticoid treatment required for managing the opportunistic pneumonia. In summary, the unique "map-like" MRI changes and extensive multi-joint involvement observed in our patient have not been widely reported in the existing literature. This distinct presentation may reflect a complex interplay between HIV infection, immunosuppressive therapy, and altered bone metabolism, warranting further investigation to elucidate the underlying pathophysiological mechanisms.

This case emphasizes the importance of early detection and intervention in patients with multi-joint osteonecrosis, particularly those with HIV and on glucocorticoid therapy. The extensive multi-joint involvement observed in this patient, involving seven joint sites including the right shoulder, bilateral hips, bilateral knees, and bilateral ankles, is relatively uncommon and can profoundly impact the patient's mobility and quality of life. Regular MRI screenings should be considered for high-risk patients to detect osteonecrotic changes early. Healthcare providers should be vigilant for symptoms of joint pain and dysfunction in this population, maintaining a high index of suspicion for osteonecrosis. Implementing standardized imaging protocols and follow-up schedules can aid in early diagnosis and timely management. In cases where osteonecrosis is detected, treatment should be promptly initiated based on the stage and severity of the lesions. Early-stage lesions may benefit from conservative management and minimally invasive procedures like core decompression, while advanced cases might require more aggressive interventions such as joint replacement surgery. These proactive measures can significantly improve patient outcomes, reduce the burden of joint disease, and enhance the overall quality of life for HIV-positive individuals.

Given the multi-joint involvement and the early stage of some osteonecrotic lesions, a customized treatment approach was adopted. Core decompression surgery, a minimally invasive procedure that creates small holes in the affected bone to improve local blood circulation, was performed on the right femur, bilateral knee joint, and bilateral ankle joints. This intervention has been shown to be effective in slowing disease progression and preserving joint function in early-stage osteonecrosis.[13,24,25] Moreover, the effectiveness of core decompression combined with platelet-rich plasma, mesenchymal stem cells, and synthetic bone grafts has been documented in improving outcomes for patients with osteonecrosis of the femoral head, suggesting potential therapeutic avenues for managing osteonecrosis in multiple joints.[26] Additionally, the patient had already undergone a right total hip replacement, and further joint replacements may be considered for other affected joints if conservative measures fail or the disease progresses. Furthermore, adjuvant therapies such as bisphosphonates and vitamin D/calcium supplementation can be considered to address the patient's concurrent osteoporosis and vitamin D deficiency, which are known risk factors for osteonecrosis and may contribute to disease progression.[5,27]

Careful follow-up and monitoring are crucial for this patient to evaluate the treatment response, monitor disease progression, and implement timely interventions as needed.[5] Regular clinical assessments, imaging studies, and laboratory tests should be performed to assess joint function, detect any new or worsening osteonecrotic lesions, and monitor bone metabolism markers. Furthermore, close collaboration between the treating HIV specialist, orthopedic surgeon, and other relevant specialists is essential to provide comprehensive care and address any potential complications or comorbidities. Additionally, further research is warranted to explore novel therapeutic approaches, such as anti-

inflammatory agents, angiogenic factors, or stem cell therapies, which may have potential in preventing or treating osteonecrosis in high-risk populations like PLWH.[28,29]

While this case report provides valuable insights into the occurrence of multi-joint osteonecrosis in an HIV-positive patient, several limitations must be acknowledged. First, the report is based on a single patient, limiting the generalizability of the findings. The unique "map-like" MRI changes observed may not be representative of all HIV-positive patients with osteonecrosis. Additionally, the case lacks a long-term follow-up to evaluate the durability of the surgical outcomes and the patient's long-term prognosis. The absence of a control group also precludes direct comparison with HIV-positive patients not undergoing glucocorticoid therapy or those receiving different treatment regimens. These limitations highlight the need for further research involving larger cohorts and longer follow-up periods to confirm and expand upon these findings.

Conclusions

This case report describes an atypical presentation of extensive multi-joint osteonecrosis in an HIV-positive patient after prolonged high-dose glucocorticoid therapy. The distinctive "map-like" pattern of osteonecrotic lesions on MRI is a rare imaging finding. The patient developed osteonecrosis involving seven joint sites, significantly impacting mobility and quality of life. A customized treatment approach combining core decompression surgery and joint replacements was adopted to preserve joint function. This case highlights the importance of close monitoring and timely interventions for HIV patients on long-term glucocorticoids, who are at increased risk of developing osteonecrosis. Early diagnosis and prompt management are crucial to alleviate symptoms and prevent further disease progression. Healthcare providers should be aware of this potential complication and maintain a high index of suspicion when treating HIV-positive patients receiving long-term glucocorticoids. Regular screening and timely referral to orthopedic specialists can facilitate early detection and intervention.

Abbreviations

HIV, Human Immunodeficiency Virus; AIDS, AcquiredImmune Deficiency Syndrome; MRI, Magnetic Resonance Imaging; CT, Computed Tomography; TDF, Tenofovir disoproxil fumarate; CRP, C-reactive protein; ESR, Erythrocyte sedimentation rate.

Consent to Participate and Ethics Statement

Written informed consent was obtained from the patient and his family. The Ethics Committee of the Beijing Ditan Hospital of Capital Medical University approved the study.

Consent for Publication

The institutional approved publication of the patient's details. The patient provided written informed consent for publication of this case report and accompanying images.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflicts of interest to declare in this work.

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