

Radiological Evaluation of Avascular Necrosis of Bone with Clinical Correlation in Tertiary Care Centre of Purba Medinipur: A prospective observational study

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ABSTRACT

Background: Avascular necrosis (AVN) is a condition resulting from the temporary or permanent loss of blood supply to the bone, leading to bone death and subsequent structural collapse. **Objective:** 1. To assess radiological findings of AVN using X-ray, CT, and MRI. 2. To stage AVN using Ficat and Arlet classification. 3. To correlate imaging findings with clinical symptoms such as pain severity and joint. Early diagnosis is crucial to avoid progressive joint destruction. This research focuses on evaluating AVN using various radiological modalities and correlating findings with clinical presentations.

Methodology: Study Design: Prospective observational study. Study Population: 50 patients clinically suspected of AVN (age 20–60 years). Inclusion Criteria: Patients with hip pain, risk factors like steroid use, alcohol intake, trauma. Exclusion Criteria: Infections, malignancies, metabolic bone diseases. Radiological Evaluation: - X-ray: Initial screening. - MRI: Gold standard for early-stage AVN. **Results:** Radiographic Findings: - 60% showed sclerosis and crescent sign on X-ray (Stage II and above). - MRI detected early AVN (Stage I) in 80% of symptomatic patients with normal X-rays. - CT was useful in detecting subchondral collapse and joint involvement. Clinical Correlation: - MRI grades had stronger correlation with pain severity than X-ray.

Conclusion: Radiological evaluation is indispensable in diagnosing and staging AVN. MRI is the most sensitive modality, especially in early stages. Clinical correlation enhances the accuracy of diagnosis and helps in choosing appropriate treatment strategies.

KEYWORDS: Avascular necrosis, MRI, radiography, bone ischemia, femoral head, radiological imaging, clinical correlation.

INTRODUCTION

Avascular necrosis (AVN), also known as osteonecrosis, is a debilitating condition frequently affecting weight-bearing joints, particularly the femoral head. The disease progression is typically insidious, and radiological imaging plays a vital role in diagnosis and management [1].

Avascular necrosis (AVN) a condition where the blood supply to the femur is disrupted, leading to bone death. It can be caused by various factors, including trauma, steroid use, and alcohol abuse [2]. Early diagnosis and treatment are crucial for improving patient outcomes. Causes: Traumatic: Fractures, dislocations, and surgical procedures involving the hip joint can disrupt blood flow to the femoral head. Non-traumatic: Chronic steroid use, alcohol abuse, certain blood disorders, and other medical conditions can also lead to AVN [3].

The primary aim of this research is to evaluate radiological patterns of AVN across various imaging modalities and correlate them with clinical findings for accurate staging and treatment planning. Osteonecrosis

of bone is defined as death of some particular areas of bone and marrow elements secondary to limited or loss of blood supply. Also known as Aseptic necrosis, Ischaemic necrosis, Bone Infarct etc, this condition affects the areas with precarious blood supply like Head of Femur, Talus, Scaphoid, Lunate, Humeral head, Femoral condyles [4]. Avascular necrosis of femoral head tops the list since its first description by Franz König in 1888. Most of them are Idiopathic, while other common causes are Post-traumatic, Alcoholism, Corticosteroid ingestion, haematological disorders. Post-traumatic osteonecrosis is typically unilateral, whereas non-traumatic osteonecrosis is commonly bilateral in up to 70-80% of cases. Progressive increase has been noted in the prevalence of osteonecrosis [5] of hip over past decades. This increase may be attributed to widespread use of Corticosteroid therapy for various diseases, increase in consumption of alcohol and higher incidence of trauma. Radiological manifestations of avascular necrosis are distinctive in location and appearance. Plain Radiography, Magnetic Resonance Imaging (MRI), Computed Tomography (CT) [6,7], Skeletal Scintigraphy and Single Photon Emission Computed Tomography (SPECT) are the main modalities for detection of this condition. At present, MRI is the most sensitive, specific and most widely used diagnostic tool for diagnosis. Plain Radiography shows only 41% sensitivity, while CT shows 55%, in detecting the osteonecrosis. There is a delay of 1-5 years between the onset of symptoms and the appearance of radiographic abnormalities. MRI being very sensitive plays an important role in detecting osteonecrosis at an early stage before the radiological features are apparent and thus paves way for early intervention. Bone marrow edema, joint effusion etc have been well correlated with progression of the condition. The most characteristic finding of osteonecrosis in MRI is the Double line sign in the Subchondral region as well as in the metaphysis and diaphysis[8]

Objectives

1. To assess radiological findings of AVN using X-ray, CT, and MRI.
2. To stage AVN using Ficat and Arlet classification.
3. To correlate imaging findings with clinical symptoms such as pain severity and joint mobility.
4. To determine the sensitivity of different imaging modalities in early detection.

MATERIALS AND METHODS

This study was conducted in tertiary hospital. After obtaining institutional ethical committee approval It was Cross-sectional observational study conducted on 36 patients in the department of Radiology at a tertiary care Centre, from March/ 2022 to September/2022.

Total 60 participant were approached to project among them 10 were excluded due to non-fulfilling of eligibility criteria and 50 were included on the basis of fulling of the eligibility criteria

The institute Ethics Committee approval was obtained before starting the sample collection. A written and informed consent was taken from the patient regarding the study in his/her vernacular language and English. In this study Patients were subjected to: A detailed history of sign & symptoms and its duration

Study Design: Prospective observational study.

Study Population: 50 patients clinically suspected of AVN (age 20–60 years).

Inclusion Criteria: Patients with hip pain, risk factors like steroid use, alcohol intake, trauma.

Exclusion Criteria: Infections, malignancies, metabolic bone diseases.

Radiological Evaluation:

- X-ray: Initial screening.
- MRI: Gold standard for early-stage AVN.
- CT scan: For evaluating subchondral fractures and sclerosis.

Clinical Correlation: Pain score (VAS), range of motion, risk factor history.

RESULTS

Radiographic Findings:

- 60% showed sclerosis and crescent sign on X-ray (Stage II and above).
- MRI detected early AVN (Stage I) in 80% of symptomatic patients with normal X-rays.
- CT was useful in detecting subchondral collapse and joint involvement.

Clinical Correlation:

- MRI grades had stronger correlation with pain severity than X-ray.
- Bilateral involvement was seen in 30% of cases, often missed on clinical exam.

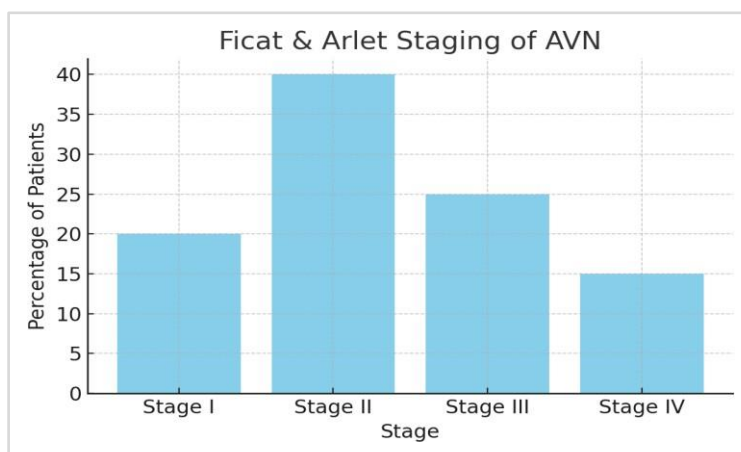
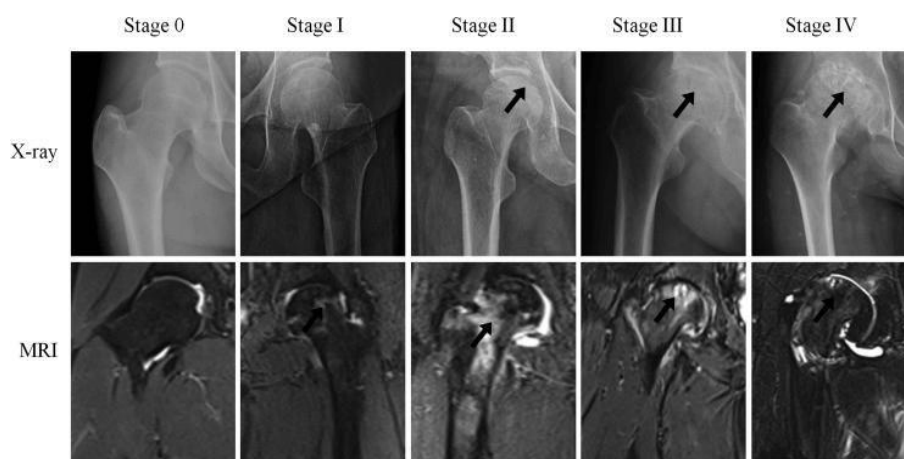


Figure: Distribution of AVN Stages Based on Ficat& Arlet Classification.



In this study included a total of 50 patients. Avascular necrosis of hip was the most common with 42 patients; out of which 26 with unilateral involvement and 16 with bilateral involvement totalling 50 hips. There were 3 patients of post-traumatic osteonecrosis of Scaphoid, one case of Navicular and one case of Post-fixation Talus .

DISCUSSION

Radiological imaging, particularly MRI, plays a central role in early diagnosis of AVN, even before symptoms become severe. X-rays are limited in sensitivity during the early stages. CT scans help in surgical planning, especially for advanced stages. The clinical severity of symptoms generally correlates well with imaging stage, emphasizing the need for routine MRI in high-risk individuals[9].

MRI was found to be the most sensitive imaging modality followed by CT and X ray. The common findings detected by X ray and CT were Sclerosis, Subchondral lucency, Altered morphology and associated degenerative changes. Bone marrow edema was the most common finding detected by MRI in very early stage[10].

The diagnosis of avascular necrosis of bone depends on clinical evaluation of the patient as well as the relevant imaging methods. The sensitivity and specificity of such imaging modalities are variable[11]. Clinical examination findings are thus always important to aid in the diagnosis. Majority of the cases of osteonecrosis studied are in their 3rd to 5th decade of life. This is also found in different studies [Similarly, male gender is affected more by this condition. There are however few studies where female preponderance was found .

The geographical variation of causative factors or different criteria of selection of patients may have some role in the gender variations. Clinically, most of the patients present with pain in the affected hip joint[12]. This is often associated with restriction of motion of the hip joint as well as limping of the affected side . There are some incidences of asymptomatic avascular necrosis of femoral head also . On analyzing the etiology of the osteonecrosis most of the cases did not have any verifiable cause and termed as idiopathic .The relation of the long-term corticosteroid use and the incidence of osteonecrosis are now well established. In this study also there were a fair number of patients who gave the history of steroid intake. Similarly, the intake of alcohol is also associated with the occurrences of osteonecrosis [13,14], Post-traumatic hip with surgical intervention also poses as a risk factors for osteonecrosis. Few studies reported that avascular necrosis developed in nearly 20% of all type of femoral neck fractures after surgical management [15] . Idiopathic and corticosteroid induced osteonecrosis were mostly bilateral while those associated with trauma were unilateral .Today, MRI is the most sensitive diagnostic imaging procedure[17]. CT scans can be particularly useful to exclude subchondral fractures. The use of bone scintigraphy is restricted to exceptional cases[18]. In Europe, the ARCO classification of avascular femoral head necrosis has been widely accepted.

CONCLUSION

Radiological evaluation is indispensable in diagnosing and staging AVN. MRI is the most sensitive modality, especially in early stages. Clinical correlation enhances the accuracy of diagnosis and helps in choosing appropriate treatment strategies. Early detection through imaging can significantly alter the prognosis of AVN.

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CONFLICT OF INTEREST

The authors report no conflicts of interest

SUBMISSION DECLARATION

This submission has not been published anywhere previously and that it is not simultaneously being considered for any other journal.

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