

Original article:

AVN OF HIP JOINT- PLAIN RADIOGRAPHIC AND MRI EVALUATION

*** Dr Ganesh Gadag, ** Dr Jeevika MU, ***Dr Kiran Kumar Hegde S**

*Junior Resident, Department of Radiodiagnosis, JJM Medical College, Davangere, Karnataka, India.

** Professor and HOD, Department Of Radiodiagnosis, JJM Medical College, Davangere, Karnataka, India.

*** Professor, Department Of Radiodiagnosis, JJM Medical College, Davangere, Karnataka, India.

*Corresponding author: Dr Ganesh Gadag

Abstract:

Introduction: Accurate diagnosis of AVN is very crucial for proper management of the patient. MRI is a non-invasive imaging modality that has excellent soft tissue resolution. The objective of the study was to accurately establish a diagnosis of AVN hip joint and to assess the role of MRI compared to radiograph in grading the severity and extent of the lesion in AVN.

Materials and methods: Present cross-sectional Study was conducted in the Department of Radiodiagnosis, JJM Medical College, Davangere, Karnataka, India in a period of two years. Before the commencement of the study, ethical clearance was obtained from the Ethics Committee, JJM Medical College, Davangere. All the patients fulfilling the selection criteria were explained about the purpose of the study and written informed consent was obtained to participate in the study before enrolment. MRI and plain AP bilateral hip RADIOGRAPHS were taken.

Results: A total of 41 hips were examined, with radiography followed by an MR examination. With a mean age of 35 years, the most common age group was 30-50 years old with male predominance. Steroids were found to be the cause of AVN in 65.2% of hips examined.

Conclusion: MRI is very sensitive in the detection of radiographically negative as well as clinically negative cases.

Keywords: AVN; HIP JOINT; MRI.

Introduction

The imaging of the hip was one of the first musculoskeletal magnetic resonance (MR) imaging applications. Because it allows examination of articular structures, extra-articular soft tissues, and the osseous structures that can be impacted by the hip disease, MR imaging is a useful tool in the evaluation of hip problems. A normal-looking radiograph, a vague history, and clinical symptoms in the setting of chronic hip pain might be a tricky diagnostic challenge. Trauma, infection, arthritis, avascular necrosis, tumors, and hip dysplasia can all result in very modest radiographic

abnormalities.¹ The primary advantage of genuine coronal and axial planes is that they produce symmetric, bilateral pictures, which can help with diagnosis and reduce the time it takes to analyze both hips.¹ On coronal MR images, the femoral head and neck, as well as the intertrochanteric region, are best appreciated. The articular region, hip musculature, and supporting ligaments can all be seen clearly with axial MR imaging. MR imaging's diagnostic ability in the evaluation of AVN is improving. MR imaging's diagnostic ability in the evaluation of AVN is improving. MR imaging is used to detect AVN in its early phases, allowing for more effective treatment and prevention of bone deterioration. The most sensitive technique for imaging AVN has been found to be MR imaging. Early intervention may be possible if asymptomatic, high-risk people are screened. The primary purpose of MR imaging is to make a diagnosis of AVN in symptomatic individuals before radiographic alterations become apparent.

Aim: - Plain radiographic and MRI evaluation of the AVN of hip

Objectives:

- To compare the findings of MR imaging with that of conventional radiography.
- To assess the importance of MRI in radiographically negative cases with a high level of clinical suspicion.
- Early detection of AVN of the opposite side in high-risk cases with known unilateral disease.

Materials and Methods:

Patients at Chigateri General Hospital and Bapuji Hospital, both affiliated with J.J.M. Medical College in Davangere, provided data for the study. The study was placed over a 24-month period, from October 2019 to October 2021, and involved 23 patients(41hips) with AVN and a history of painful hip joints. T1, T2, PDFS, and STIR sequences were included in the MRI scan protocol, those with a history of trauma (within the previous month), non-compatible implants, and other factors were omitted.

23 patients (41 hips) underwent plain radiography followed by MR examination for the evaluation of AVN of the hip. Radiographic examination was done on both conventional and digital radiography. All MRI examinations were done on a 1.5T Philips Achieva machine.

INCLUSION CRITERIA:

- All positive cases of osteonecrosis underwent first radiography followed by MRI.
- All age groups.
- Both sexes.

EXCLUSION CRITERIA:

- Patients having a history of trauma
- Patients with congenital hip conditions or tumours were not a part of this study
- Patients with a history of claustrophobia or a history of metallic implants insertion, cardiac pacemakers, and metallic foreign body in situ were excluded from this study.

Preparation:

- History and physical examination of all patients were performed.
- Patients were asked to remove all ornaments & metallic accessories.
- The technique was described to the patients, and they were told not to move during the scan.

Technique:

- All the patients underwent MRI scanning at our department on Philips Achieva 1.5 Tesla.
- The patient was placed supine on the table and the area from the vertex to the skull base was included.
- MRI bilateral hips were performed with T1, T2, PDFS, STIR, and T2* sequences.

IMAGE ANALYSIS

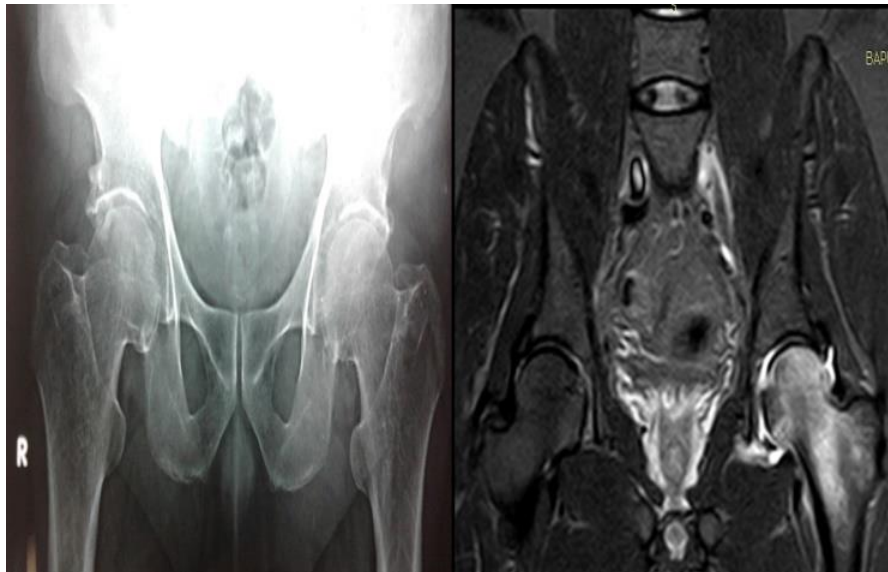
- Plain radiographs were evaluated according to FICAT and ARLET classification, MR evaluation was performed based on Mitchell's grading.

Method: Statistical analysis of this cross-sectional study is performed and descriptive tables are formulated. Microsoft Office 2019 is used for statistical analysis.

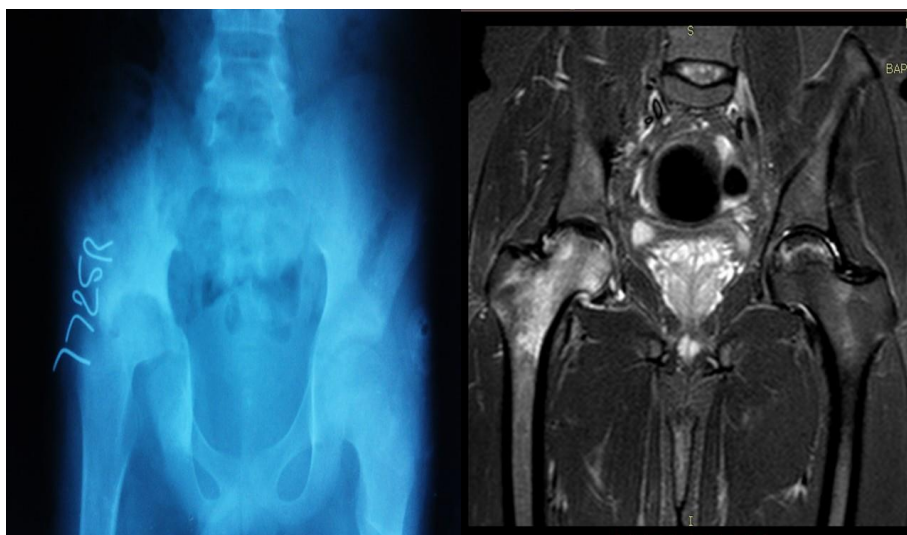
Results:

1. The most common age group was 30-50 yrs., with a mean age group of 35 yrs.
2. Males were more commonly affected about 60.97% (n=25 hips) among 41 hips studied.
3. Hip pain is present in all cases and it is associated with limp in 17 cases.
4. Steroids were the causative factor of AVN in 15(65.2%) patients.
5. Radiograph detected AVN 23 (56%) of 41 hips studied.

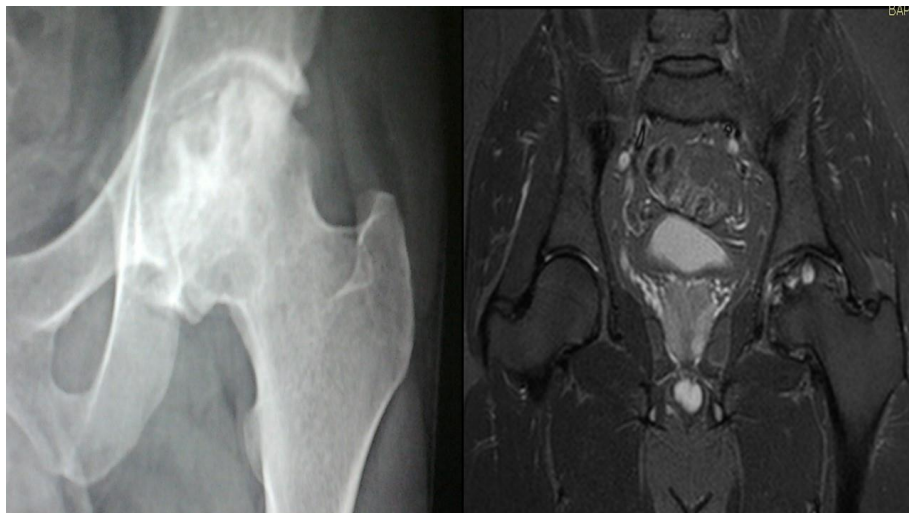
Case 1: NORMAL RADIOGRAPH & MRI SHOWING STAGE 1 AVN ON LEFT SIDE



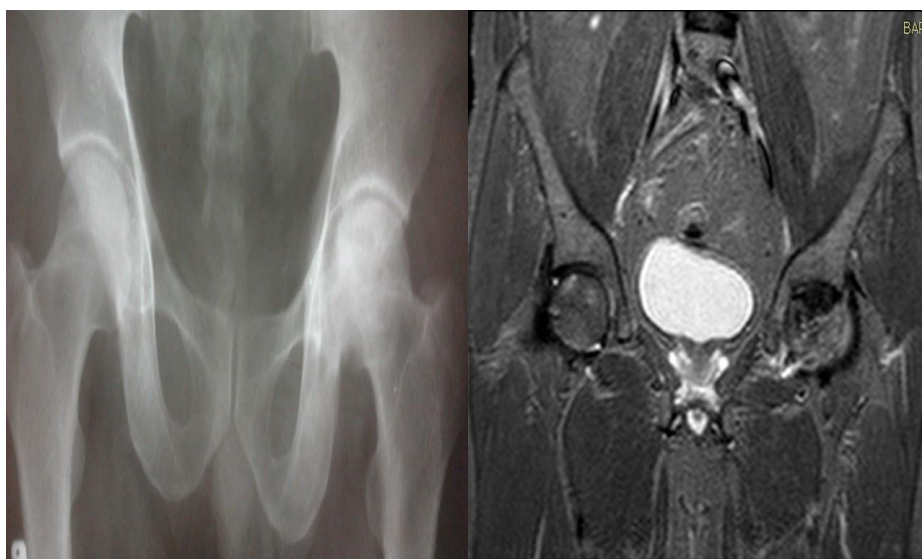
Case 2: BILATERAL AVN – STAGE 3 ON RIGHT SIDE AND STAGE 2 ON LEFT SIDE



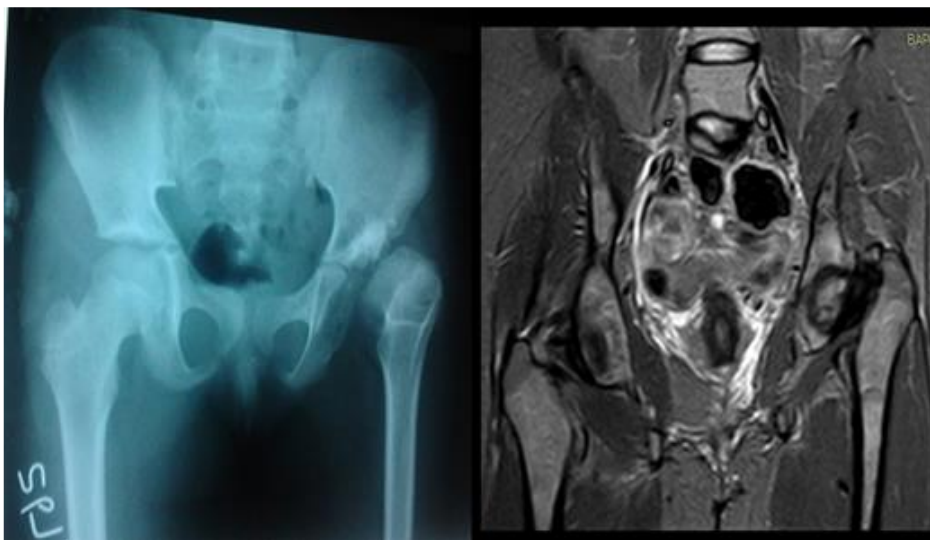
Case 3: STAGE 3 AVN ON LEFT SIDE



Case 4: STAGE 3 AVN OF LEFT HIP



Case 5: STAGE 3 AVN ON LEFT SIDE AVN STAGE 4 ON LEFT SIDE



Discussion:

Out of 23 (56%) hips diagnosed on plain radiography, 1 (4.3%) hip showed subchondral cysts and osteoporosis suggestive of stage I AVN {FICATS staging}. 8 (34.7%) hips showed mixed osteopenia and/or sclerosis and/or subchondral cysts, without any subchondral lucency suggestive of stage II AVN {FICATS staging}. 7 (30.4%) hips showed crescent sign, suggestive of stage III AVN {FICATS staging}. 7 (30.4%) hips showed ankylosis, suggestive of stage IV AVN {FICATS staging}.

Of all the 41 hips detected on MRI, 17 (41.5%) hips showed fat signal and 10 (24.4%) hips showed signal of subacute blood suggesting it to be a common associated feature that can be detected only on MRI as radiography has its limitation in diagnosing bone marrow edema. 7 (17.1%) hips showed bone marrow edema in the femoral head, 7 (17.1%) hips showed signal analogous to fibrosis. Bilateral involvement is seen in 18 cases, 3 cases with right hip and 2 case with left hip involvement. Steroid being the most common cause of AVN. In comparison to study done by Mitchell DG et.al⁹ which showed a characteristic "double-line sign" consisting of high signal intensity inside a low-intensity peripheral rim was seen in 45 lesions (80%).⁹ In our study "double-line sign" was present in 32 hips (78%). Symptoms were least severe in lesions isointense with fat and most severe in lesions with low-signal central regions.

In comparison to the study done by Robinson HJ et. al.¹¹ in which twenty-three of the

ninety-six hips that were suspected of having early-stage necrosis of the femoral head but showed slight or no radiographic changes were studied by repeat radiographs. Of the twenty-three hips, eighteen (78 percent) had positive changes on magnetic resonance imaging.¹¹ In our study out of 43 hips, MRI detected 43 hips (100%), whereas radiography could detect only 23 cases (56%).

In 1989, Hauzeur J.P. et al.¹² conducted research comparing MRI results with plain radiography, radionuclide bone scanning, and core biopsy specimens of 25 patients with femoral head osteonecrosis. Plain radiographs had a sensitivity of 67%, radionuclide scans had a sensitivity of 77%, and MRI had a sensitivity of 100%. In all of the hips with histological confirmation of osteonecrosis, they concluded that MRI was precise.¹² In our study MRI detected 100 % hips with AVN and radiograph detected only 56% of cases.

Conclusion:

Due to its multiplanar capabilities and high tissue characterisation property, MRI is particularly sensitive in early detection of radiographically negative as well as clinically unsuspected cases of avascular necrosis of the femoral head. It can also be used as a screening procedure to check the opposite side in persons who have a known unilateral ailment in high-risk populations.

The available classification systems are complimentary to each other and objectively grades the severity of AVN to determine the optimal therapy and thus allows the surgeon achieve a better choice of treatment and improve the outcome. The only limitation of MRI is its high cost and relatively sparse availability.

References:

- 1) Manaster BJ. Adult chronic hip pain: radiographic evaluation. *Radiographics*. 2000 Oct;20(suppl_1):S3-25.
- 2) Gabriel H, Fitzgerald SW, Myers MT, Donaldson JS, Poznanski AK. MR imaging of hip disorders. *Radiographics*. 1994 Jul;14(4):763-81.
- 3) Berquist TH, editor. *MRI of the musculoskeletal system*. Lippincott Williams & Wilkins; 2012 Apr 6. 204-318.
- 4) Drake RL, Vogl WA, Mitchell AW, Schmitt W, Gruliow R. Lower limb. In: *Gray's anatomy for students*. 2nd ed. Philadelphia, PA: Churchill Livingstone; 2010. p. 528-35.
- 5) Campbell SE. Radiography of the hip: lines, signs, and patterns of disease. In *Seminars in roentgenology* 2005 Jul 1 Vol. 40, No. 3, pp. 290-319.
- 6) Yochum TR, Rowe LJ, Pope Jr TL. *Essentials of Skeletal Radiology*, vols 1. and 2. *AJR- American Journal of Roentgenology*. 1996;167(1):190-.
- 7) Resnick D, Niwayama G. Osteonecrosis: diagnostic techniques, specific sites and complications. *Diagnosis of Bone and Joint Disorders*. 1995;5:3496-558.

- 8) Ficat RP. Necrosis of the femoral head. Ischemia and necrosis of bone. 1980:171-82.
- 9) Mitchell DG, Rao VM, Dalinka MK, Spritzer CE, Alavi AB, Steinberg ME, Fallon M, Kressel HY. Femoral head avascular necrosis: correlation of MR imaging, radiographic staging, radionuclide imaging, and clinical findings. *Radiology*. 1987 Mar;162(3):709-15.
- 10) Beltran J, Herman LJ, Burk JM, Zuelzer WA, Clark RN, Lucas JG, Weiss LD, Yang A. Femoral head avascular necrosis: MR imaging with clinical-pathologic and radionuclide correlation. *Radiology*. 1988 Jan;166(1):215-20.
- 11) Robinson, H. J., Jr, Hartleben, P. D., Lund, G., & Schreiman, J. (1989). Evaluation of magnetic resonance imaging in the diagnosis of osteonecrosis of the femoral head. Accuracy compared with radiographs, core biopsy, and intraosseous pressure measurements. *The Journal of bone and joint surgery. American volume*, 71(5), 650–663.
- 12) Hauzeur, J. P., Pasteels, J. L., Schoutens, A., Hinsenkamp, M., Appelboom, T., Chochrad, I., & Perlmutter, N. (1989). The diagnostic value of magnetic resonance imaging in non-traumatic osteonecrosis of the femoral head. *The Journal of bone and joint surgery. American volume*, 71(5), 641–649.