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**ORIGINAL RESEARCH**

# MRI and CT scan in patients with osteonecrosis of the femoral head- A Comparative study

[1]Dr. Saurabh Agarwal, [2]Dr. Gunjan Das

[1]Professor, Department of Orthopaedics, Career Institute of Medical Sciences & Hospital, Lucknow, U.P., India
[2]Professor, Department of Radio Diagnosis, Career Institute of Medical Sciences & Hospital, Lucknow, U.P., India

**Corresponding author**
Dr. Gunjan Das
Professor, Department of Radio Diagnosis, Career Institute of Medical Sciences & Hospital, Lucknow, U.P., India

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## ABSTRACT

**Background:** Osteonecrosis, also known as avascular necrosis of bone, is a condition in which osteocytes and marrow components die as a result of the bone's vascularity being damaged.The present study was conducted to compare MRI and CT scan in patients with osteonecrosis of the femoral head. **Materials & Methods:** 70 cases of osteonecrosis of the femoral head of both genders underwent CT and MRI scans. **Results:** Out of 70 cases, 40 were males and 30 were females. The mean lesion volume measured from gross specimen was 20.4 $cm^3$, CT was 22.3 $cm^3$, and MRI was 22.5 $cm^3$. Lesion volume measured from CT by radiologist 1 was 22.6 $cm^3$ and from radiologist 2 was 22.9 $cm^3$. Lesion volume measured form MRI from radiologist 1 was 22.3 $cm^3$and from radiologist 2 was 23.4 $cm.^3$ **Conclusion:** For individuals with ONFH in Association Research Circulation Osseous stage III or higher, CT and MRI can accurately depict the lesion features.

**Keywords:** CT, MRI, Osteonecrosis



## INTRODUCTION

Osteonecrosis, also known as avascular necrosis of bone, is a condition in which osteocytes and marrow components die as a result of the bone's vascularity being damaged.[1]

The word "osteonecrosis" is commonly used instead of "avascular necrosis" because blood vessels are still there but destroyed.[2,3] There are numerous potential causes of osteonecrosis, including trauma, systemic or local steroid use, vasculitis, hyperlipidemia, sickle cell anemia, Gaucher disease, pancreatitis, alcoholism, AIDS, radiation, and emboli. Idiopathic refers to a subgroup of cases.[4] When bone necrosis occurs without infection or neoplasia, it is not considered osteonecrosis.[5] The commonly used Steinberg classification, which is based on both radiographic and MRI data, divides osteonecrosis into six stages. Stage I osteonecrosis is by definition invisible on radiographs.[6]

Characteristic radiography, CT, MRI, or radionuclide bone scintigraphic findings can be used to diagnose osteonecrosis.[7] The conventional method for determining the degree of hip degeneration in AVN is plain-film radiography. Although tomograms and radiographs can both be helpful in identifying AVN, MRI is more sensitive than both in this regard.[8]The present study was conducted to compare MRI and CT scan in patients with osteonecrosis of the femoral head.

## MATERIALS & METHODS

The study was conductedon 70 cases of osteonecrosis of the femoral head of both genders. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded.Coronal CT and MRI scans were performed on the necrotic femoral head specimens within four hours of the procedure. The specimens were then clamped onto a bench according to the femoral head's anteversion angle, which was determined by MR imaging. Lines were drawn on the femoral heads at 5-mm intervals along the coronal plane, and the specimens were then cut into 5-mm thick blocks. We were able to ascertain whether CT could clearly depict the location, shape, and spatial structural relationship of the lesion as observed on the gross specimen and MR images, as well as the changes in MRI signal intensity and CT imaging density, by comparing the

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results of the coronal sectional specimens with the MR and CT coronal images.Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

## RESULTS

**Table I Distribution of patients**

| Total-70 | | |
|---|---|---|
| **Gender** | **Male** | **Female** |
| Number | 40 | 30 |

Table I shows that out of 70 cases, 40 were males and 30 were females.

**Table II Lesion volume measured from gross specimen, CT and MR images**

| Method | Mean | P value |
|---|---|---|
| Gross specimen | 20.4 | 0.85 |
| CT | 22.3 | |
| MRI | 22.5 | |

Table II, graph I shows that mean lesion volume measured from gross specimen was 20.4 cm3, CT was 22.3 $cm^3$, and MRI was 22.5 $cm^{3.}$ The difference was non- significant (P> 0.05).

**Graph I Lesion volume measured from gross specimen, CT and MR images**

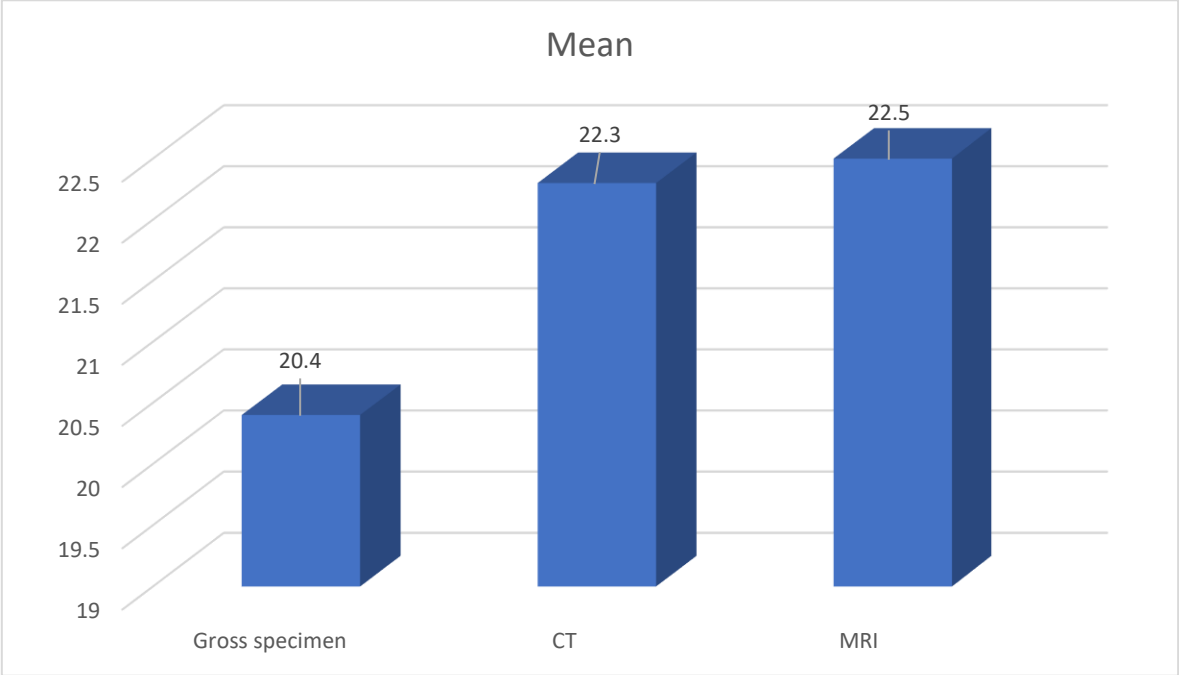


**Table III Lesion volume measured from CT and MR images between 2 radiologists**

| Method | Radiologist 1 | Radiologist 2 | P value |
|---|---|---|---|
| CT | 22.6 | 22.9 | 0.82 |
| MRI | 22.3 | 23.4 | 0.54 |

Table III shows that lesion volume measured from CT by radiologist 1 was 22.6 $cm^3$ and from radiologist 2 was 22.9 $cm^3$. Lesion volume measured form MRI from radiologist 1 was 22.3 $cm^3$and from radiologist 2 was 23.4 $cm.^3$ The difference was non- significant (P> 0.05).

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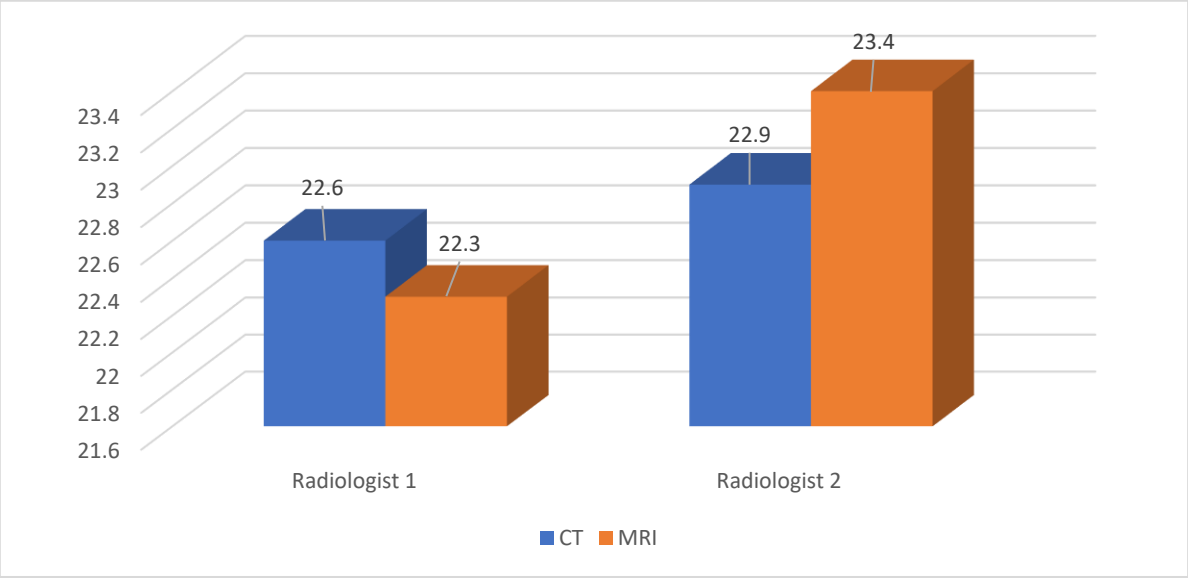
**Graph I Lesion volume measured from CT and MR images between 2 radiologists**




## DISCUSSION

One prevalent condition affecting the hip joint is osteonecrosis of the femoral head (ONFH). Within a few years of the disease progressing, 80% of patients with ONFH will have the collapse of the femoral head articular surface if treatment is not received.[9,10] Osteoarthritis will inevitably develop and the hip joint's function will be severely compromised once the femoral head collapses, ultimately necessitating mechanical joint replacement. In the short term, hip replacement is a good way to reduce pain and enhance hip function, but its long-term results are still not sufficient.[11,12]The present study was conducted to compare MRI and CT scan in patients with osteonecrosis of the femoral head.

We found that out of 70 cases, 40 were males and 30 were females. Beltran JA et al[13] performed aretrospective evaluation of magnetic resonance (MR) imaging for the detection of avascular necrosis (AVN) of the femoral head was performed in 49 patients (85 hips) with clinical suspicion of AVN. Positive findings at bone biopsy or evidence on plain radiographs was considered proof of AVN. Absence of clinical symptoms and of radiographic findings for a minimum of 18 months after MR imaging was considered evidence of the absence of AVN. All patients were studied with plain radiography and technetium-99m methylene diphosphonate bone scintigraphy. Five hips had negative MR images, positive findings at bone marrow biopsy, positive bone pressure measurement (BMP), and positive bone scans. A comparison between MR images and bone scans showed MR imaging to be superior, with a sensitivity of 88.8% (vs. 77.5%) and a specificity of 100% (vs. 75%). BMP was the most sensitive (92%) but least specific test (5%).

We found that mean lesion volume measured from gross specimen was 20.4 cm3, CT was 22.3 $cm^3$, and MRI was 22.5 $cm.^3$ Robinson et al[14] in their study, the accuracy of magnetic resonance imaging in the detection of osteonecrosis of the femoral head was compared with that of other diagnostic methods in current use: plain radiography, bone-marrow pressure determinations, intramedullary venography, and histological examination of core-biopsy bone specimens. In the first phase of the study, forty-eight patients (ninety-six hips) who were at high risk for avascular necrosis were studied. Abnormal patterns on magnetic resonance imaging, consistent with those seen in necrosis, were found in all hips that were suspected of having Ficat Stage-2 or 3 changes on the basis of radiographic evidence of the disease. Abnormal patterns on magnetic resonance imaging that were characteristic of avascular necrosis were also observed in 17 per cent of the hips that were suspected of having Ficat Stage-0 changes and in 64 per cent of those that showed Stage-1 changes, all with no radiographic changes. In the second phase of the study, 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, Ficat functional evaluations of bone, core biopsies of the femoral head, and magnetic resonance imaging. Of the twenty-three hips, eighteen (78 per cent) had positive changes on magnetic resonance imaging; nineteen (83 per cent) had positive histological evidence of necrosis; and fourteen (61 per cent) had positive findings by bone-marrow pressure studies and intramedullary venography. Although false-negative and false-positive results were observed with magnetic resonance imaging, the over-all results of this study suggest that magnetic resonance imaging may be useful for the early diagnosis of avascular necrosis.

We found that lesion volume measured from CT by radiologist 1 was 22.6 $cm^3$ and from radiologist 2 was 22.9 $cm.^3$ Lesion volume measured form MRI from

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radiologist 1 was 22.3 $cm^3$and from radiologist 2 was 23.4 $cm.^3$ Hu et al[15] looked into how well osteonecrosis of the femoral head (ONFH) lesions could be described using CT and MRI. Thirty femoral head specimens obtained from twenty-three patients who had undergone hip arthroplasty due to ONFH were subjected to coronal CT and MRI scans. The outcomes were contrasted with observations from gross specimens from coronal sections. Using computer software, two radiologists independently calculated the volume of necrotic lesions from CT and MR images. The results were then averaged. The water displacement method was used to estimate the necrotic lesion's volume in the specimens. The location, form, and spatial structure of lesions were highly consistent across CT, MRI, and the coronal sectional gross specimen. Two radiologists' differences in lesion volume as determined by CT and MR images were not statistically significant. Necrotic lesion volumes were $22.07 \pm 5.35$, $22.21 \pm 5.15$, and $21.12 \pm 4.96$ cm3, respectively, based on CT and MR images and gross specimens. The differences were not statistically significant ($F = 0.396$) and $p = 0.674$).
The limitation of the study is small sample size.

## CONCLUSION

Authors found that for individuals with ONFH in Association Research Circulation Osseous stage III or higher, CT and MRI can accurately depict the lesion features.

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