

Plain Radiograph and MR Evaluation of Painful Hip Joint

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Abstract

Background: In this study, we wanted to make a distinction between numerous painful hip joints and conditions revealed by an MRI and determine the severity and extent of underlying lesions in diverse situations.

Materials and Methods: This was a cross-sectional study conducted among 50 patients from the Konaseema Institute of Medical Sciences and Research Foundation in Amalapuram, over 18 months from June 2019 to December 2021.

Results: The most common illness identified because an explanation for painful hip in our study was avascular necrosis (AVN) of the femoral head. Only 2 (6.66%, n=30) of 9 (30%, n=30) AVN cases discovered on MRI were diagnosed on plain radiography. Osteoarthritis was found in 6 (20%, n=30) instances. Both simple X-rays and MRIs revealed all six cases.

Conclusion: In the diagnosis and therapy of paediatric hip problems, magnetic resonance imaging (MRI) is becoming increasingly effective. MR imaging provides various benefits, which are especially relevant within the paediatric population.

Keywords: Plain Radiograph, Magnetic Resonance Imaging, Avascular Necrosis.

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Background

The role of resonance imaging in the evaluation of arthritis has become increasingly important. The foremost common arthritis in children is juvenile rheumatoid arthritis, and it's uniquely capable of depicting soft tissue abnormalities that occur in juvenile rheumatoid arthritis including joint effusion, synovial inflammation, and articular cartilage degradation.

MR imaging revealed marrow changes in sarcoidosis patients with musculoskeletal symptoms and soft tissue lesions that are

missed on radiographs. Because most dysplasias are easily detected with plain radiography, resonance imaging is used. MR imaging is frequently useful in the evaluation of a range of hip diseases. We believe imaging protocol and a spotlight on the intricacies of MR examination technique as vital for optimising diagnostic potential within the workout of hip disease.

Successful hip investigations are inspired by specific techniques that include surface coil imaging, oblique image acquisition,

and different pulse sequences. GRE sequences are crucial in the assessment of cartilaginous diseases, notably in paediatric hip illness. High-resolution direct MR imaging of the hip is currently used as the best method for evaluating intra-articular pathology of the hip. However, for detection of minor bone anomalies associated with femoroacetabular impingement, plain radiography is used.

Study's Objectives

- To make a distinction between numerous painful hip joints and conditions revealed by an MRI.
- Determine the severity and extent of the underlying lesions in diverse situations.

Results

Table 1: Pathology

Sl. No	Pathology	Number of Patients	%
1.	AVN	9	30%
2.	joint effusion	8	26.66%
3.	O. A	6	20%
4.	T.B.	4	13.33%
5.	Perthes	1	3.33%
6.	DDH	1	3.33%
7.	Metastasis	1	3.33%
	Total	30	100%

Avascular Necrosis of Femoral Head

AVN of the femoral head was found in 9 (30%) of the 30 patients. Only 2 (22.2 percent) of the 9 cases of AVN were recognised on X-ray, however, all 9 (100 percent) were detected on MRI. On MRI, 7 (77.7%) cases that were normal on X-ray and stage 1 and stage 2 of the FICAT CLASSIFICATION were found to have AVN. 2 (22.2 percent) of the cases were recognised on both X-ray and MRI. FICATS indicates stage 3 or above on MRI in 1 (50 percent) of these cases that was diagnosed as stage 2 on X-ray. 1 (50%) of the cases that was identified as

Methodology

This was a cross-sectional study conducted among 50 patients from the Konaseema Institute of Medical Sciences and Research Foundation in Amalapuram, over 18 months from June 2019 to December 2021.

Inclusion Criteria

Patients with acute or persistent hip pain were included in the trial. Patients of all ages and genders were welcome.

Exclusion Criteria

Patients having a history of severe trauma. Patients having a history of claustrophobia. Patients having a history of metallic implants, cardiac pacemakers, and metallic foreign bodies in situ.

stage 4 on X-ray FICATS also showed stage 4 on MITCHELL'S MRI.

Joint Effusion

Eight (26.66%) of the thirty cases had joint effusion. On X-ray, two incidences of joint effusion (25%) were found out of eight patients. On MRI, all eight cases (100%) showed evidence of joint effusion.

X-ray findings included: teardrop distance had been expanded, T2W and STIR hyperintensity within the joint space, which might be minor, moderate, or severe, according to MRI findings.

Osteoarthritis

Six (20%) out of the thirty cases had osteoarthritis. All six cases were detected on both conventional radiography and MRI. But out of 6 cases, 2 cases showed stage 2 on X-ray. In this, 1 case showed stage 2 and another case showed stage 3 on MRI and 3 cases which were showing stage 3 on X-ray showed stage 3 on MRI also and another case showed stage 4 on both X-ray and MRI.

Out of 6 cases detected on X-ray, stage 2 (2 cases), stage 3 (3 cases), and stage 4 (1 case). On MRI, stage 2 (1 case), stage 3 (4 cases) and stage 4 (1 case).

TB of Hip Joint

Out of 30 cases, 4 cases (13.3%) showed TB HIP. Out of 4 cases of TB HIP, 3 (75%) cases were detected on X-ray, whereas 4 (100%) cases were detected on MRI. 3 cases detected on X-ray, showed stage 1(0 case), stage 2(1 case), stage 3 (1 case), stage 4 (0) & stage 5 (1 case).

Whereas 6 cases detected on MRI showed stage 1 (0 case), stage 2 (0 case), stage 3 (1 case), stage 4 (1 case) & stage 5 (1 case).

Perthes Disease

Out of 30 cases, 1 case (3.33%) showed Perthes disease. And this case was detected on both X-ray (100%) and MRI (100%).

Developmental Dysplasia of Hip

Out of 30 instances, one (3.33%) had hip dysplasia due to developmental dysplasia and both X-ray and MRI detected this situation (100 %).

Metastases

Out of 30 cases, 1 case (3.33%) showed developmental dysplasia of hip disease. And this case was detected on both X-ray (100%) and MRI (100%).

Discussion

Plain radiography is a well-established, low-cost technique for imaging the hip

during a range of medical contexts. MRI, on the other hand, is an upscale and inaccessible investigation at the primary level of health care [1,2]. However, it is the non-invasive gold standard in early diagnosis, more precisely assessing the extent of disease involvement, and reducing medical diagnosis.

Our aim of the study was to use MRI to detect disease before radiographic signs appear or in patients with subtle indications on plain radiography, allowing the doctor to treat a patient at an early stage to stop disease development [3-6].

It also aims to appropriately stage disease and assess the extent of pathology involvement in cases previously diagnosed on X-ray, using MRI to guide the clinician in appropriate treatment counting on the stage of pathology involvement [7-9]. Our discussion further demonstrates that MRI is the gold standard for evaluating soft tissue and articular cartilage, which are difficult to identify abnormalities with conventional radiography.

Avascular Necrosis of Femoral Head

The most common aetiology identified for painful hip in our study was AVN of the femoral head. Only 2 (6.66%, n=30) of 9 (30%, n=30) AVN cases discovered on MRI were diagnosed on plain radiography. 2 (22.2 percent, n=9) instances were diagnosed with a clear X-ray. 1 (11.1 %, n = 9) instance had subchondral cysts and osteoporosis, indicating stage 2 AVN (FICATS staging). 1 (11.1 percent, n=9) instance included a crescent sign, changed head shape, and osteoporosis, indicating stage 3 AVN (FICATS staging). Of nine instances discovered on MRI, all of them (100 percent, n=9) indicated bone marrow oedema, suggesting that it is the foremost prevalent feature seen and should only be seen on MRI, whereas X-ray has limitations in identifying bone marrow oedema [10-14].

On MRI, 7 (77.7 percent, n=9) cases had a double line sign, which suggested that on

T2W sequences, the inner bright line represented granulation and thus surface dark line represented sclerotic bone. On MRI, 1 (11.1 percent, n=9) case identified as stage 2 (FICATS) on plain X-ray exhibited stage 3 alterations.

MRI evaluates better than X-ray in staging and assessing the extent of pathological involvement in previously proven cases of AVN on plain radiography, which aids the doctor in developing an appropriate treatment strategy relying on the stage of AVN.

Our findings are like those of Robinson HJ Jr. *et al.*, [15] who examined repeat radiographs on 23 of 96 hips suspected of getting early-stage femoral head necrosis but showing very minor or no radiographic alterations. Of 23 hips, 18 (78%) demonstrated positive alterations on resonance imaging; in our study, MRI found 9 cases (100%) out of 9 hips, whereas radiography detected just 2 cases (22.2 percent).

Osteoarthritis

In our investigation, osteoarthritis was found in 6 (20%, n=30) instances. Both simple X-rays and MRIs revealed all six cases.

Six cases out of six were found to be positive on an easy X-ray. 2 (33.3 percent, n=6) individuals were classified as having stage 2 (Kellgren and Lawrence staging) with probable joint space constriction and definitive osteophytes. 3 (50 percent, n=6) instances had obvious constriction of joint space inferiorly, mild sclerosis, and osteophytes at stage 3.

1 (16.6 percent, n=6) case had considerable narrowing of joint space, obvious osteophytes, cyst formation, and femoral head and acetabulum deformation.

Stage 2 is defined as inhomogeneity of articular cartilage with high signal on T2W sequences and unclear trabeculae or signal intensity reduction in the femoral head and neck on T1W sequences. 4 patients (66.6

percent, n=6) indicated stage 3, which encompassed requirements of stages 1 & 2 also as an ambiguous zone between the femoral head and thus acetabulum, also as subchondral signal loss because of bone loss. 1 (16.6 percent, n=6) patient met stage 1, 2, and three criteria and featured a femoral head deformity. Thus, MRI allows for better delineation of cartilage loss also as accurate pathology involvement and staging of osteoarthritis, which assists clinicians in designing an appropriate treatment or intervention plan.

Joint Effusion

In our study, 8 (26.66%, n=30) cases showed joint effusion. On MRI, all eight cases were found (100%), however, only two (25%, n=8) cases were detected on ordinary X-ray. On plain X-ray, 2 cases (25 percent, n=8) exhibited widened teardrop distance.

On MRI, joint effusion was shown as a high signal intensity, indicating fluid collection within the joint space, in both T2W and STIR sequences. MRI is beneficial for assessing and quantifying some fluid within joint space, which may be classified as mild, moderate, or severe joint effusion.

On MRI, four patients (50 percent, n=8) had mild joint effusion, three (37.5 percent, n=8) had moderate joint effusion, and one (12.5 percent, n=8) had severe joint effusion.

On MRI, 5 (62.5%, n=8) cases identified as normal on conventional X-ray were revealed as positive for joint effusion.

As a result of our research, we conclude that MRI is more sensitive in detecting joint effusions in cases when plain radiography shows normal or modest alterations, even where there is a high clinical suspicion, and it also aids in better measurement of joint fluid collection.

Thus, our findings demonstrate that MRI is more sensitive in detecting joint effusions, particularly when conventional

radiography shows normal or mild alterations despite strong clinical suspicion. It also contributes to more accurate quantification of joint fluid collection.

Tuberculosis of Hip Joint

In our investigation, 4 cases (13.3 percent, n=30) were diagnosed with TB hip. Plain X-ray was used to diagnose three instances (75 percent, n=4). Whereas on MRI, all four instances were diagnosed (100%, n=4). One (25 percent, n=4) example demonstrated just osteopenia, joint effusion, and soft tissue oedema. Three cases (75 percent, n=4) had osteopenia, joint erosions, and decrease in joint space.

1 (25%) (n=4) case had a joint injury also called as bony ankylosis. On MRI, four (100 percent, n=4) cases were identified. In one (25 percent, n=4) instance on plain x-ray there was just synovial T2W hyperintensity and joint effusion within sort of high signal intensity within joint space in T2W and STIR sequences, which was assessed as normal.

It demonstrates the usefulness of MRI in the early identification of tuberculosis when plain X-rays show normal despite significant clinical suspicion. On STIR sequence, 1 (25 percent, n=4) patient demonstrated synovial hyperintensity, joint effusion, and bone marrow oedema as high signal intensity within the marrow. 1 (25 percent, n=4) patient had subarticular T2 hyperintense cysts with a discount in joint space. On T2W, 2 instances (50 percent, n=4) demonstrated bone marrow oedema, joint space reduction, and para-articular soft tissue hyperintense signal. 1 (25%) example had substantial joint degradation and bony ankylosis, as seen by hypointensity on both T1W and T2W, also as para-articular soft tissue involvement.

Thus, within the early stages of TB Hip, where traditional X-ray is restricted in diagnosis, MRI aids in the finer delineation of synovial involvement and detection of joint effusion. In the early

stages of tuberculosis, MRI also can detect bone marrow oedema. Hip MRI allows for a more accurate assessment of the extent of articular cartilage injury also as para-articular soft tissue involvement when standard X-rays are utilised to spot a case.

Perthes Disease

Perthes disease was detected in 1 (3.33%, n=30) case in our study, the only instance that was diagnosed using both X-ray and MRI (100 percent, n=1). On plain X-ray, 1 (100%, n=1) case revealed termination of femoral epiphyseal growth within sort of tiny epiphyses and total resorption of femoral epiphyses within healed/residual stage. On MRI, 1 (100%, n=1) instance revealed only femoral epiphyseal growth arrest, epiphyseal abnormalities within sort of T1 hyperintensity, T2W hyperintensity, bone marrow oedema within sort of STIR hyperintensity, and metaphyseal T2W hyperintensities.

Our findings are analogous to those of Toby EB, Koman LA, and Bechtold RE9, who examined paediatric hip disease in 24 children by scanning their hips (30 scans). Twelve Legg-Calvé-Perthes disease patients (17 hips) displayed discrete regions of low-intensity signal, indicating necrotic capital epiphysis. Both cases in our investigation exhibited small epiphyses that were hypointense on T1W but hyperintense on T2W.

As a result, MRI can help with the evaluation of femoral epiphyses and therefore detection of bone marrow oedema on STIR sequence.

Developmental Dysplasia of Hip (DDH)

In our study, 1 (3.33%, n=30) instance was diagnosed with DDH on both plain X-ray and MRI (100%, n=1).

1 (100%, n=1) example had femoral epiphysis displacement lateral to Perkin's line but inferior to Hilgenreiner's line. The same condition was seen on MRI, including epiphyses displacement, hyperintensity of epiphyses on T2W, and

bone marrow oedema as hyperintensity on STIR sequence. 1 (100%) case featured an entire femoral head dislocation with a fractured Shenton's line and epiphyses superior to the acetabular rim. On MRI, additionally to epiphyses displacement and femoral head dislocation, it also revealed tiny epiphyses and hypointense epiphyses on both T1W and T2W.

As a result, X-ray remains the initial line of study for DDH diagnosis. MRI, on the other hand, aids in the higher evaluation of epiphyses and femoral head pathological involvement, also because of detection of related bone marrow oedema and evaluation of epiphysis and femoral head displacement.

Metastasis

In our investigation, 1 (3.33%, n=30) case of hip metastases was identified that was diagnosed using both plain X-ray and MRI (100 percent, n=1). On plain X-ray, 1 (100%, n=1) patient had osteolytic lesions within the femoral head. On MRI, the femoral head's signal intensity was altered on the T2W sequence.

On plain X-ray, 1 (100%, n=1) patient had osteoblastic lesions and sclerosis within the femoral head. On MRI, there was a change within the shape of the femoral head also as increased signal intensity within sort of a hyperintense signal on T2W sequence, with accompanying para-articular soft tissue involvement within sort of a hyperintense signal on T2W sequence.

Thus, MRI is preferable for the diagnosis of metastatic lesions because it not only detects abnormal signal intensity lesions but also accurately analyses cartilaginous and soft tissue involvement, which aids in the development of an appropriate treatment plan.

Conclusion

In the diagnosis and therapy of paediatric hip problems, magnetic resonance imaging (MRI) is becoming increasingly effective.

MR imaging provides various benefits, which are especially relevant within the paediatric population. Because such tons of paediatric hips are cartilaginous, simple radiography is typically insufficient. Because most dysplasias could be easily detected with plain radiography, MR imaging isn't utilized within traditional work-up of patients with bone dysplasias.

Early detection of AVN using MR imaging allows for early treatment and prevention of bone degeneration. MR imaging has been determined to be the most sensitive approach for visualising AVN. Soft-tissue abnormalities associated with arthritis, such as synovial inflammation, joint effusion, and articular cartilage deterioration, can only be seen with MR imaging. MRI can detect joint effusion and synovial proliferation more accurately than traditional radiography. In establishes cases on plain radiography, like Perthes disease and metastatic hip illness, MRI helps in improved disease staging, amount of pathogenic involvement, and soft tissue extension. It is particularly sensitive to changes in the bone marrow which can signify pathology that's not visible on conventional radiography of hips.

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