# Imaging spectrum of non-infective causes of monoarticular arthritis

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**Conflict of interest: Nil**

**Abstract:**

Introduction: Monoarticular arthropathy is a common entity seen in a rheumatology clinic. Non-infective causes form major part of morbidity.
Conventional radiography is the basic first line investigation in assessing any monoarticular joint disease. Magnetic resonance imaging (MRI) is very costly, whereas Ultrasonography (USG) is very easily available and very cheap as compared to MRI. Patients with significant soft tissue abnormalities can be diagnosed at an earlier stage by USG and MRI, avoiding delay in treatment. Plain radiograph and Computed tomography (CT) are used as first line investigations to screen any osseous pathology, calcifications, subchondral fractures and for diagnosing early bone erosions.
Aim: of the study is to evaluate the various monoarticular arthropathies of non-infective origin in relation to age, sex and pattern of involvement radiologically.
Materials & methods: It is an observational study on 37 patients conducted in the Department of Radiology, Silchar Medical College & Hospital (SMCH), Silchar, Assam, india from 1st June 2017 to 31st May 2018 using X ray, CT and MRI.
Results: Out of 37 patients with monoarticular arthropathy of non-infective origin, osteoarthritis was the commonest pathology causing monoarticular involvement corresponding to 35.13 % (13 out of 37) ,followed by AVN involving 27.02 % (10 out of 37) of cases, inflammatory arthritis involved 16.21 % (6 out of 37) of cases. PVNS comprised of 10.8 % cases, gout and synovial chondromatosis 5.40 % each.
Conclusion: Imaging plays a important role in diagnosing . First line investigation is plain radiography. In diagnosing joint effusions, soft tissue changes and synovial thickening, ultrasound had an excellent sensitivity . Radiation risks of CT narrows down its use, although it has a definitive role . MRI is both specific and sensitive, so it is the imaging modality of choice. The only limitation being high cost and more time consumed.

**Keywords:** Monoarticular arthritis, non-infective, X ray, CT, MRI
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## Introduction

Monoarticular arthropathy is a common entity seen in a rheumatology clinic. Patients may have self limited conditions, but certain urgent conditions demand early diagnosis to avoid significant morbidity and mortality.

Although infective causes form significant number of morbidity, non-infective causes also form major part of morbidity. Common causes of chronic arthropathy are indolent infections like tuberculosis, fungal and chronic inflammatory causes like chronic gout and osteoarthritis[1].

The evaluation of a monoarticular arthropathyof non-infective origin consists of taking a detail history and performing physical examination complemented with radiography.

Conventional radiography is the basic first line investigation in assessing any monoarticular joint disease. Magnetic resonance imaging (MRI) is very costly, which is a limiting factor in a very large group of population. On the other hand Ultrasonography (USG) is very easily available and very cheap as compared to MRI. Patients with significant soft tissue abnormalities can be diagnosed at an earlier stage by USG and MRI, avoiding delay in treatment.

Computed tomography (CT) is used when there is a need for precise localization and an additional diagnosis of soft tissue changes or treatment monitoring. Plain radiograph and CT are used as first line investigations to screen any osseous pathology, calcifications, subchondral fractures and for diagnosing early bone erosions.

**Aim**

The aim of the study is to evaluate the various monoarticular arthropathies of non-infective origin in relation to age, sex and pattern of involvement radiologically.

**Methods and materials:**

It is an observational study, conducted in the Department of Radiology, Silchar Medical College & Hospital (SMCH), Silchar, Assam from 1st June 2017 to 31st May 2018 after taking approval from the ethical committee in clinic-pathologically confirmed cases of monoarticular arthritis of non-infective origin . It is a tertiary care Indian hospital. A total of 37 patients of confirmed cases of monoarticular arthritis patients of non-infective origin were evaluated with various imaging modalities.

The patients referred from the Departments of Orthopedics, Medicine, Surgery and Pediatrics of SMCH. After history taking and physical examinations in all cases, informed consent obtained from the subjects before commencing the investigations.

Inclusion criteria was all clinicopathologically confirmed cases of monoarticular arthritis of non-infective origin. Exclusion Criteria were other simultaneous joint disease, acute traumatic bone fractures / dislocations /subluxations and patients contraindicated for CT & MRI examination.

Radiographs were taken using Siemens 500 mA (Model-Klinoskop H / Fluoro-vision) machine in two planes perpendicular to each other, PA/AP view and lateral view of the joint involved.

X-Ray protocol: kVp used: 60-85kV, mAS used: 2-6 mAS, FFD: 100-115 cms.

Postero-anterior view (PA) of the joint involved: The patient is either supine or seated on the X-ray table. The radiograph is taken with the central ray at 90 degrees to the long axis of the joint passing through the joint.

Lateral view of the joint involved: The patient lies on the side to be examined, the joint positioned in the vertical plane and fixed with the help of sand bag.

Computed Tomographic (CT) evaluation: PHILIPS INGENUITY ELITE / 128 slice MDCT used for evaluation, scan were done in required cases only to prevent undue radiation risk. Contiguous 2-3 mm thick were obtained in axial planes routinely. Multiplanner reconstruction in other planes and 3D reconstructions were used wherever required. Radiation safety measures were taken.

USG evaluation: HD 11 XE PHILIPS ultrasonography machine, with a high frequency (5 -12MHz) linear probe used for evaluation of joint involved .Doppler techniques were used evaluation of vascularity of a lesion. Bilateral examination and comparison with the healthy side in various scanning planes were done .

MRI evaluation: MRI was done almost for all cases in our study. MRI evaluation was carried out on SIEMENS TIM AVANTO 1.5T SCANNER.

MRI protocol: The involved joint was positioned in the circular polarized extremity coil [By Siemens for routine orthopedic imaging {dimensions - 405 mm × 270 mm × 290 mm (L × W × H)}] . Proper cushioningdone to prevent movement. Contrast study was performed whenever required, Gd DTPA-dimeglumine solution was injected IV in a dosage of 0.1 mmol per kilogram body weight as a bolus and was followed by a saline flush.

MRI images were acquired in sagittal, coronal and axial planes in T1, T2 and PDFS images. For all sequences 256x256 matrix was used



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.Additional sequences were taken wherever required – gradient sagittal/axial/coronal, three-dimensional GRE pulse, FS sequence, were done. Pre and Post contrast T1FS axial, sagittal and coronal images were taken.

Results

Out of 37 patients with monoarticular arthropathy of non-infective origin, osteoarthritis was the commonest pathology causing monoarticular involvement corresponding to 35.13 % (13 out of 37) ,followed by AVN involving 27.02 % (10 out of 37) of cases, inflammatory arthritis involved 16.21 % (6 out of 37) of cases. PVNS comprised of 10.8 % cases, gout and synovial chondromatosis 5.40 % each.

| Arthropathies | Cases | Percentage |
|---|---|---|
| Osteoarthritis | 13 | 35.14 |
| AVN | 10 | 27.03 |
| Inflammatory arthritis | 6 | 16.22 |
| PVNS | 4 | 10.81 |
| Gout | 2 | 5.40 |
| Synovial chondromatosis | 2 | 5.40 |
| Total | 37 | 100 |

Table 1- Distribution of non-infective monoarticular arthropathies.

Age distribution of the pathologies:

The most common age group in our study was in the range 30-39 years (36.7% cases). This was followed by the age range 40-49 years (23.3% cases).



| Age | 0-20 years | 20-40 years | 40-60 years | >60 years | Total |
|---|---|---|---|---|---|
| No. of cases | 0 | 12 | 20 | 5 | 37 |
| Percentage | 13 | 69.6 | 17.4 | 0 | 100 |

Table 2 - Age distribution of non-infective monoarticular arthropathies

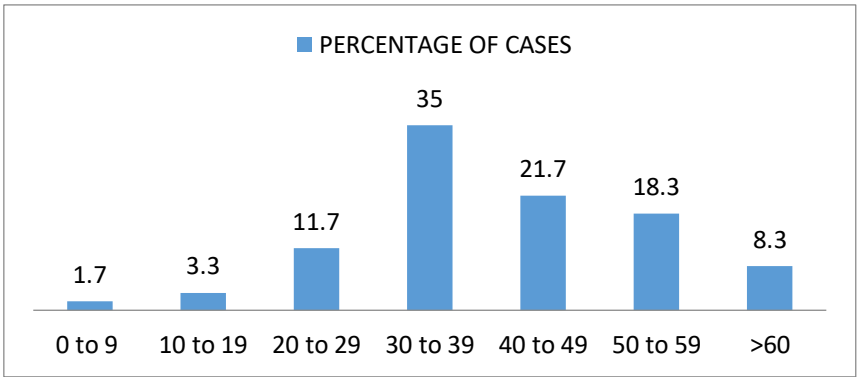



Fig 1- Bar diagram showing age distribution of monoarticular arthropathies

Sex distribution of monoarticular arthropathies:

In our study males (65%) were more common compared to females (35%). In cases of inflammatory arthritis and osteoarthritis however a female preponderance was noted.

| Pathologies | Male | Female |
|---|---|---|
| Osteoarthritis | 5 | 8 |
| AVN | 8 | 2 |
| Inflammatory arthritis | 2 | 4 |
| PVNS | 4 | 0 |
| Gout | 1 | 1 |
| Synovial chondromatosis | 2 | 0 |
| Total | 22 | 15 |

Table 3 - Sex distribution of non-infective monoarticular arthropathies

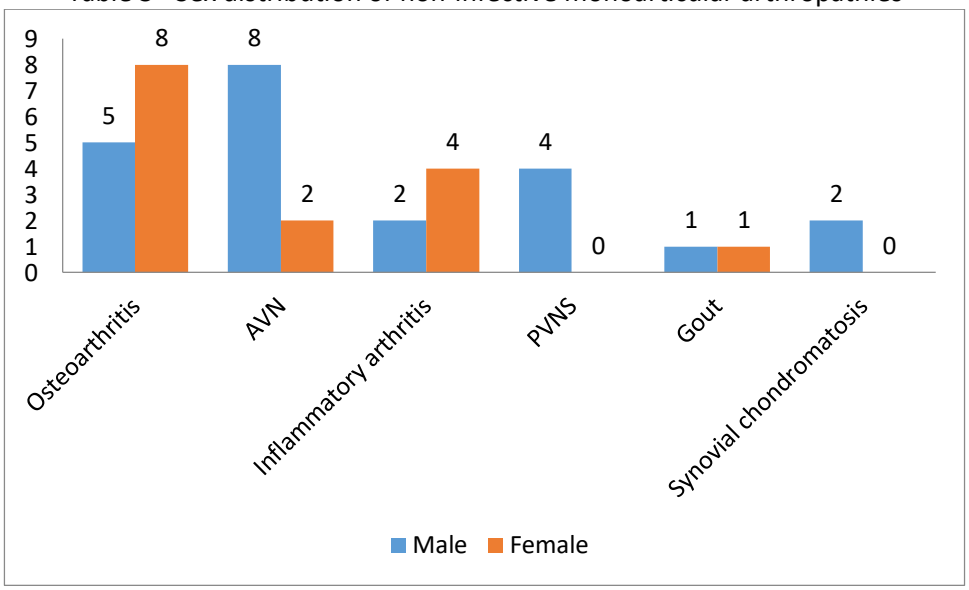



Fig 2 – Bar diagram showing sex distribution of monoarticular arthropathies

Monoarticular affection of different joints

In our study irrespective of the etiology, knee joint was the most common joint to be affected. Hip joint was the most common joint involved in AVN in our study.

| Joint involved | Cases | Percentage |
|---|---|---|
| Knee joint | 16 | 43.24 |
| Hip joint | 10 | 27.03 |
| Wrist joint | 3 | 8.11 |
| Ankle joint | 2 | 5.41 |
| PIP | 4 | 10.81 |
| MCP | 1 | 2.70 |
| MTP | 1 | 2.70 |
| Total | 37 | 100 |

Table 4 – Joint distribution of non-infective monoarticular arthropathies

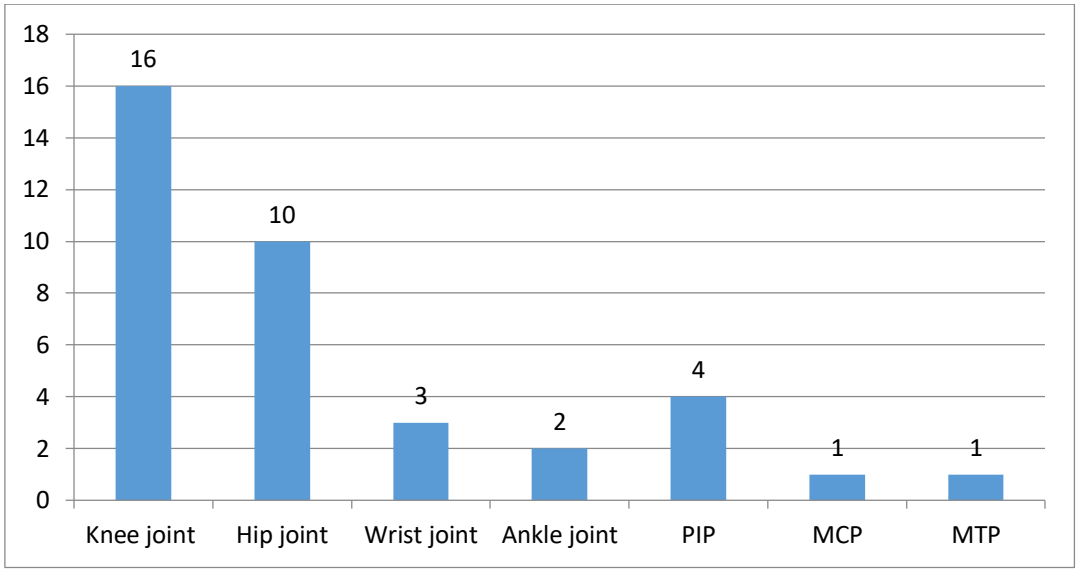



Fig 3 – Bar diagram showing joint distribution of monoarticular arthropathies



Radiographic features of osteoarthritis:

In the present study, the most common radiographic finding in osteoarthritis was the presence of osteophytes and joint space narrowing seen in all the cases and subchondral changes were seen in 10 cases.

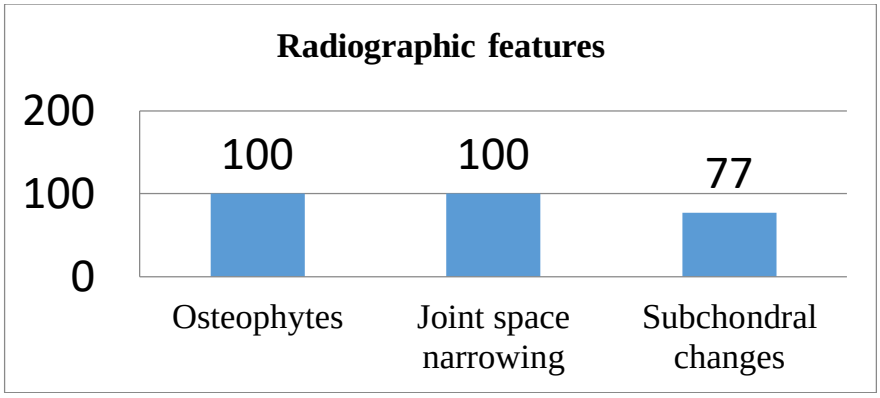



Fig 4 – Bar diagram showing radiographic features of osteoarthritis

**USG features:**

In this study, osteophytes were seen in 9 cases, articular cartilage thinning in 6 cases and joint effusion in 5 cases out of a total of 13 cases.

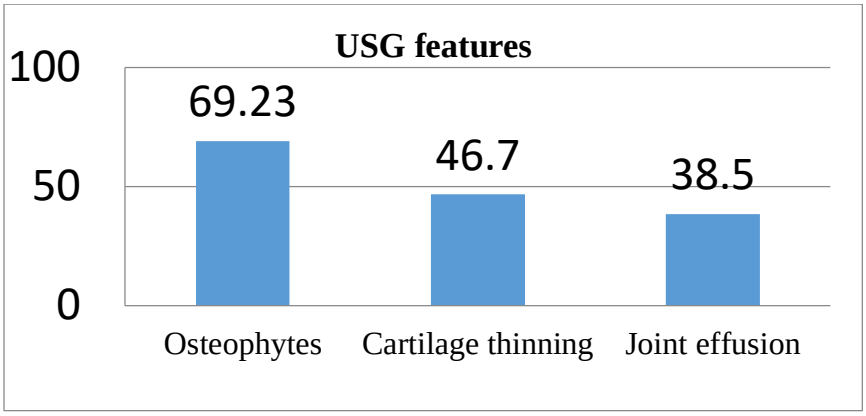



Fig 5 – Bar diagram showing USG features of osteoarthritis

CT features:
Presence of osteophytes and joint space narrowing were common findings seen in all the cases. Subchondral changes in the form of subchondral cysts and sclerosis were noted in 8 cases.



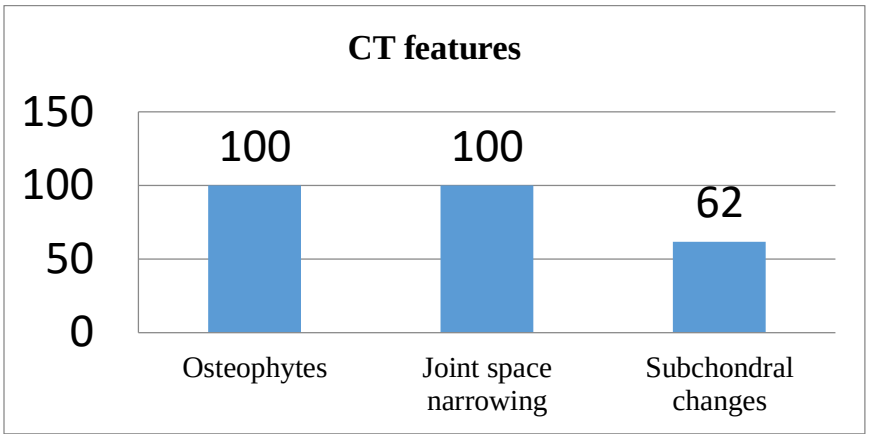



Fig 6 – Bar diagram showing CT features of osteoarthritis

MRI features:
Articular cartilage thinning, osteophytes and joint effusion were the most common MRI features of osteoarthritis, seen in allcases. Subchondral changes were seen in 10 cases and bone marrow oedema in 4 cases.

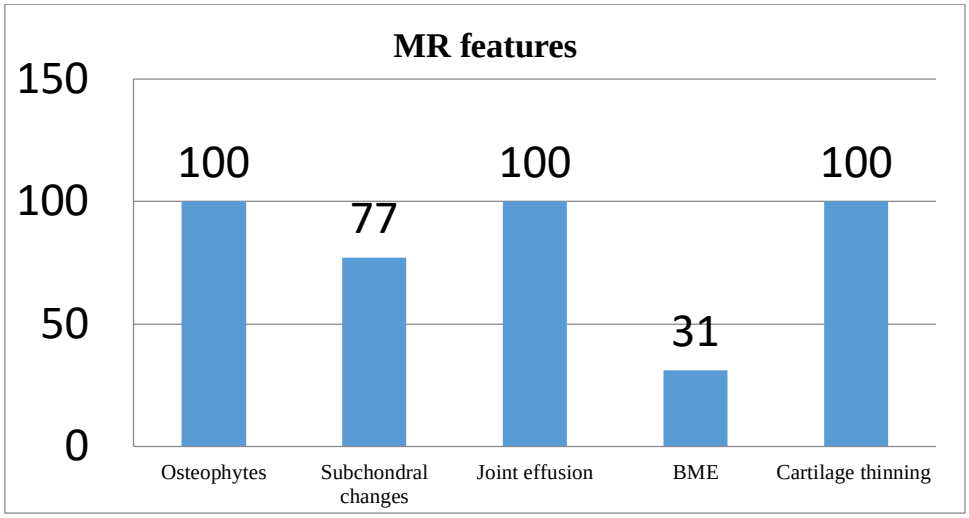



Fig 7 – Bar diagram showing MR features of osteoarthritis

Sensitivity of imaging modalities in diagnosis of osteoarthritis:

The sensitivity of diagnosis of osteoarthritis by Plain radiography was 85%, by USG was 54%, by CT was 100% and by MRI was 100%. MRI and CT showed higher sensitivity when compared to other modalities.

| Modality | Radiography | Ultrasound | CT | MRI |
|---|---|---|---|---|
| No. of cases diagnosed | 11 | 7 | 11 | 13 |
| Sensitivity | 85 | 54 | 85 | 100 |



Table 5 – Sensitivity of imaging modalities

Radiographic featuresof avascular necrosis (AVN)

In this study all the 10 cases of AVN showed sclerosis, altered morphology of the involved segment (collapse, flattening, fissuring or contoural irregularity) and subchondral changes (collapse and air crescent sign following fracture). Degenerative changes (osteophytes, joint space reduction or subchondral cysts) were seen in 7 cases and neck widening in 4 cases.

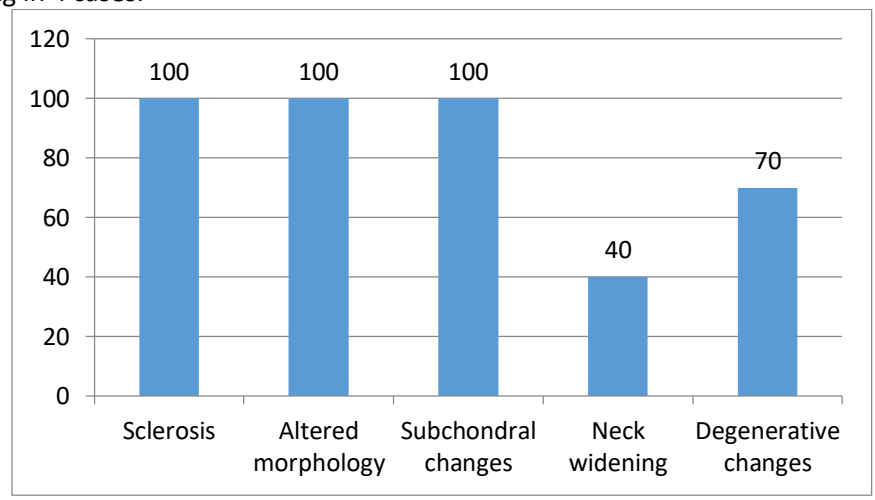



Fig 8 – Bar diagram showing Radiographic features of AVN

CT features:

The most common CT feature of AVN was altered morphology which included flattening, contoural irregularity, collapse and fissuring of the involved segment and subchondral changes. Osteophytic lipping (degenerative changes) was seen in 7 cases. Sclerosis was seen in 9 cases.

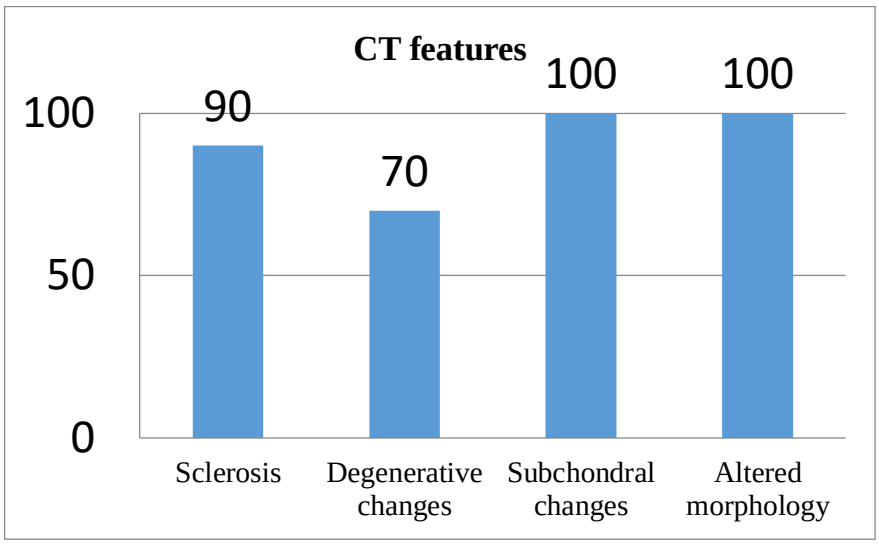



Fig 9– Bar diagram showing CT features of AVN

MRI features:

Altered morphology (flattening, fissuring, contoural irregularity and collapse), altered marrow signal and subchondral changes (sclerosis, fracture and collapse) were seen in all cases. Joint effusion and degenerative changes were seen in 7 cases.



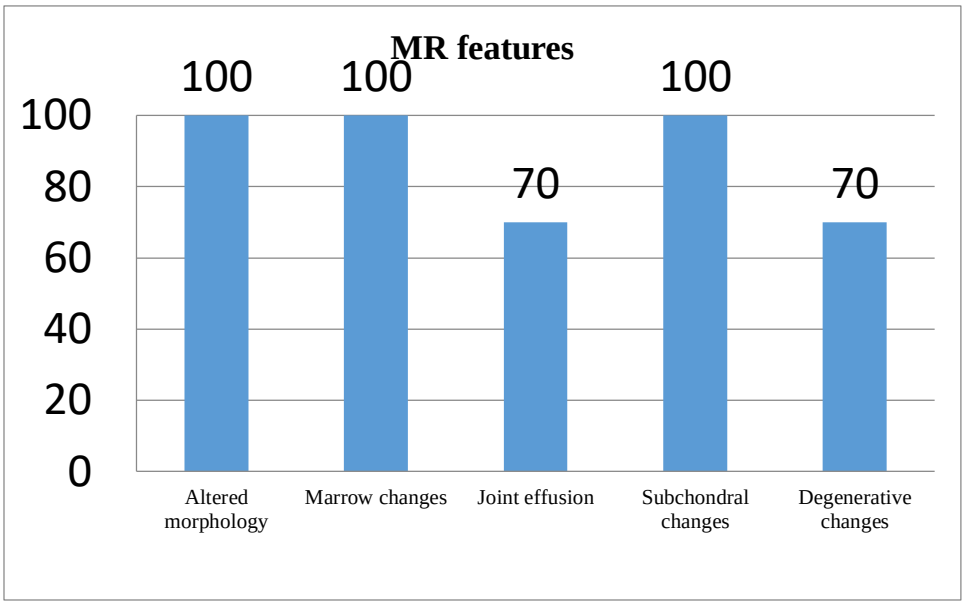



Fig 10 – Bar diagram showing MR features of AVN

Sensitivity of imaging modalities in diagnosis of AVN:

MRI had a sensitivity of 100% in diagnosing AVN whereas CT and Radiograph had a sensitivity of 80% each.

| Modality | Radiograph | CT | MRI |
|---|---|---|---|
| No. of cases diagnosed | 8 | 8 | 10 |
| Sensitivity | 80 | 80 | 100 |



Table 6 – Sensitivity of imaging modalities

Radiographic features of inflammatory arthritis :
Subchondral changes were seen in 5 cases out of 6 cases in our study. Erosions and joint space narrowing were seen in 4 cases.

| Radiograph features | Erosions | Joint space narrowing | Subchondral changes |
|---|---|---|---|
| No. of cases | 4 | 4 | 5 |
| Percentage | 66.7 | 66.7 | 83.3 |

Table 7 – Radiographic features of inflammatory arthritis

USG features:
On USG, all the cases showed joint effusion. Synovial thickening was noted in 5 cases and synovial hyperemia in 4 cases. Bone erosions were seen in two cases.

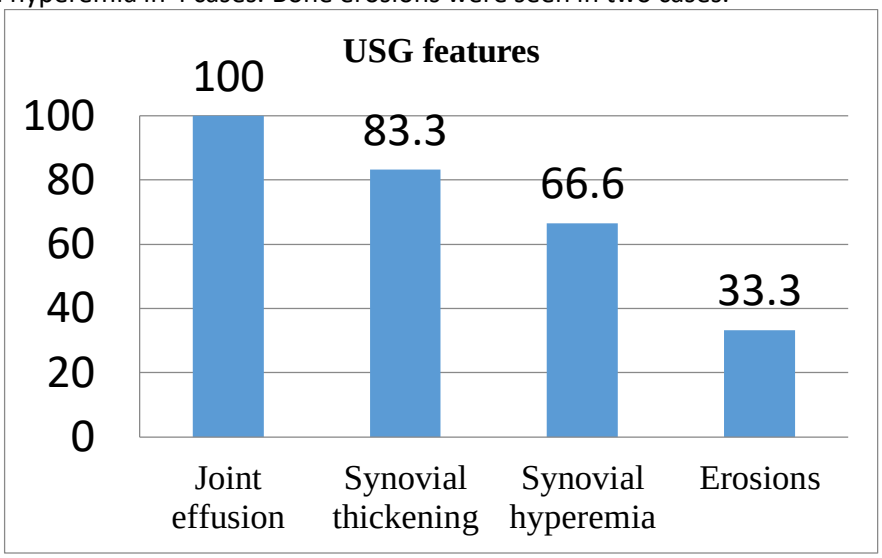



Fig 11 – Bar diagram showing USG features of inflammatory arthritis

CT features:
Joint effusion was noted in the all the 6 cases. Erosions and joint space narrowing was noted in 4 cases each and osteopenia and synovial thickening in 3 cases each.

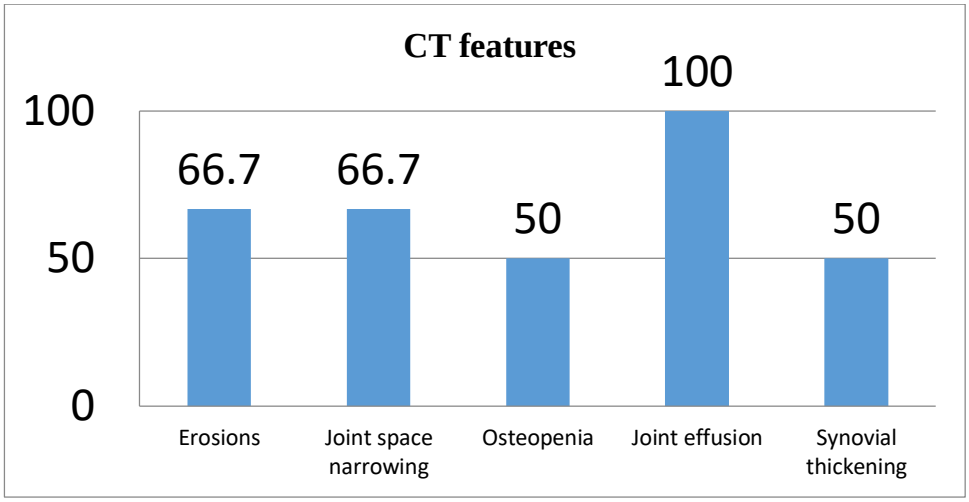



Fig 12 – Bar diagram showing CT features of inflammatory arthritis

MRI features:

On MRI, joint effusion and synovial thickening with enhancement were the most common findings and it was present in all the 6 cases that were studied. Erosions were noted in 4 cases. Bone marrow oedema and cartilage defects were seen in 3 cases each. 6958

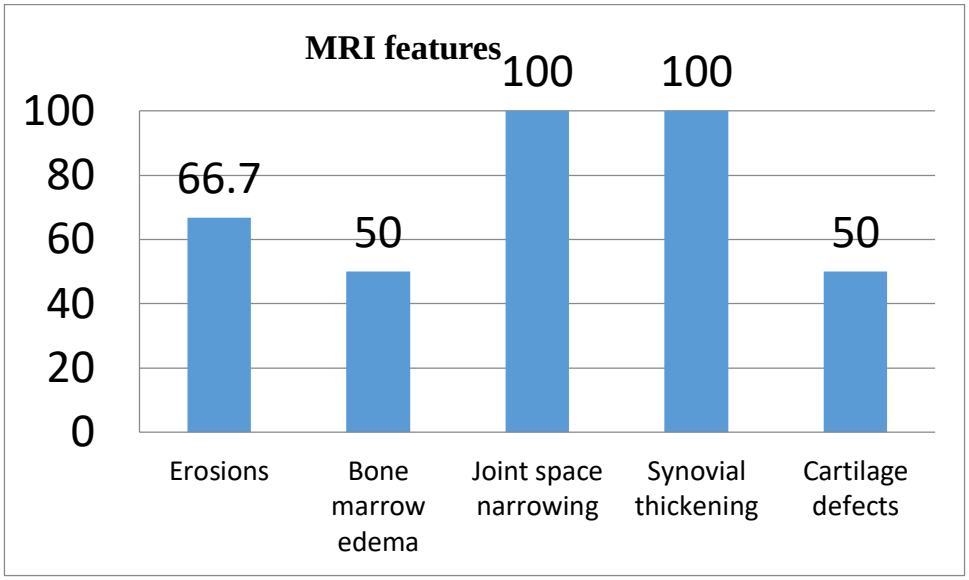



Fig 13– Bar diagram showing MR features of inflammatory arthritis

Sensitivity of imaging modalities in diagnosis of inflammatory arthritis:

CT and MRI had sensitivity of 100% in diagnosing inflammatory arthritis. USG had a sensitivity of 66.6% and radiograph had a sensitivity of 33.3%.

| Modality | Radiograph | USG | CT | MRI |
|---|---|---|---|---|
| No. of cases diagnosed | 2 | 4 | 6 | 6 |
| Sensitivity (Percentage %) | 33.3 | 66.6 | 100 | 100 |

Table 8 – Sensitivity of imaging modalities

Radiological features of Pigmented villonodular synovitis (PVNS)
Out of the 4 cases of PVNS, soft tissue swelling was noted in 3 cases, erosions in 2 cases and subchondral changes in 1 case.

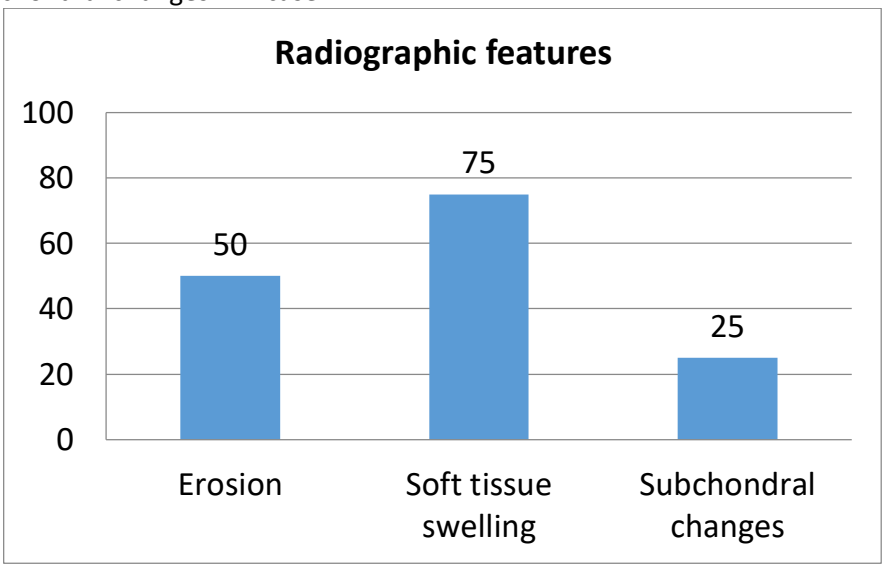



Fig 14 – Bar diagram showing radiographic findings in PVNS



USG features :
On USG, all 4 cases showed joint effusion and nodular synovial thickening. Echogenic masses were noted in 2 cases.

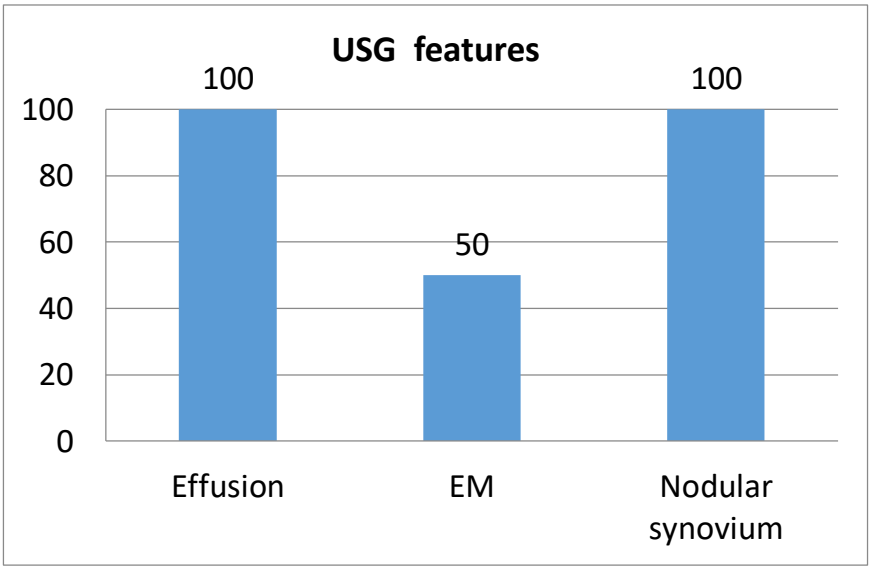



Fig 15 – Bar diagram showing USG features of PVNS

CT features:
On CT, all 4 cases showed soft tissue masses and joint effusion. Erosions were seen in 2 cases.

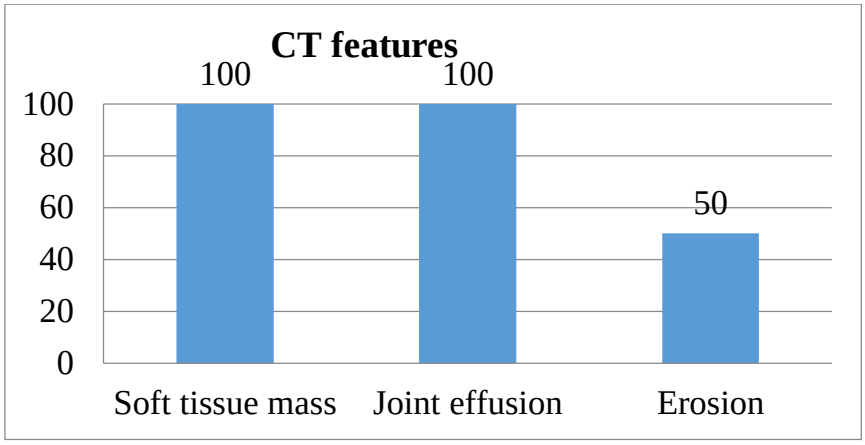



Fig 16 – Bar diagram showing CT features of PVNS

MRI features:

All 4 cases showed blooming on GRE due to haemosiderin deposition which was characteristic for PVNS. Nodular synovial thickening which had T1 and T2 hypointensities were seen in all the cases. Joint effusion was seen in all the cases in the present study.



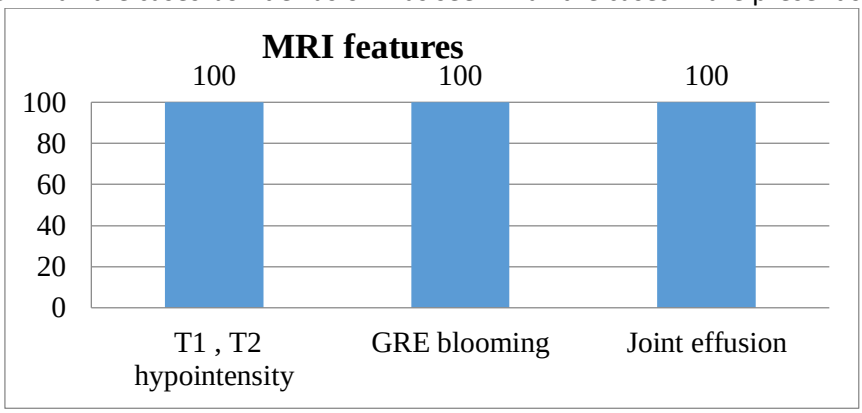



Fig 17 – Bar diagram showing MR features of PVNS

Sensitivity of imaging modalities in diagnosis of PVNS:

Radiograph and USG could not diagnose PVNS in our study. CT had a sensitivity of 25% in our study while MRI had a sensitivity of 100%.

| Modality | Radiograph | Ultrasound | CT | MRI |
|---|---|---|---|---|
| No. of cases diagnosed | 0 | 0 | 1 | 4 |
| Sensitivity | 0 | 0 | 25 | 100 |

Table 9 – Sensitivity of imaging modalities

Radiographic features of gout:

Soft tissue opacification due to deposition of tophi was seen in both the cases along with the typical punched out erosions (also known as rat bite erosions). Joint effusion is a very early finding in a case of Gout seen in one case in our study.

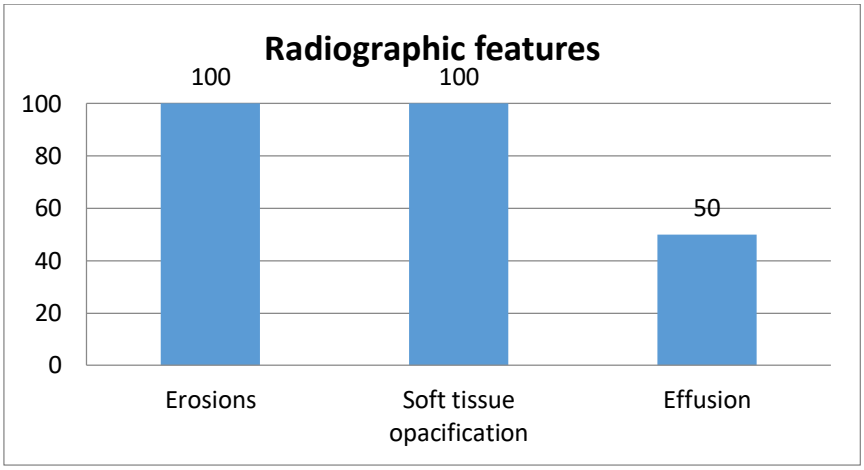





Fig 18 – Bar diagram showing Radiographic features of Gout

USG features:

Both the cases showed the soft tissue tophi with adjacent erosions and synovial hyperemia on Doppler study.

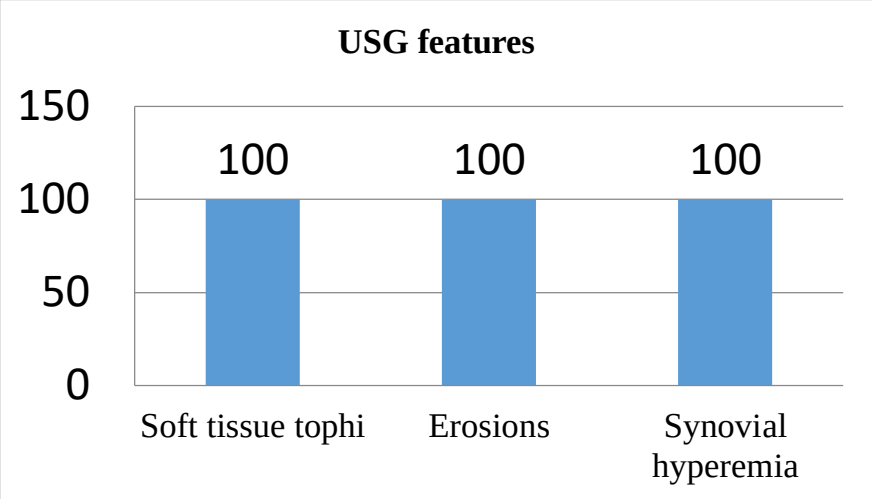



Fig 19 – Bar diagram showing USG features of Gout

CT features:

Both the cases showed erosions and tophi on CT.

MRI features:

On MRI both the cases showed a soft tissue mass which was T1 isointense and of variable signal intensity on T2. Erosions and synovial thickening was seen in both the cases. Joint effusion was seen in one case.

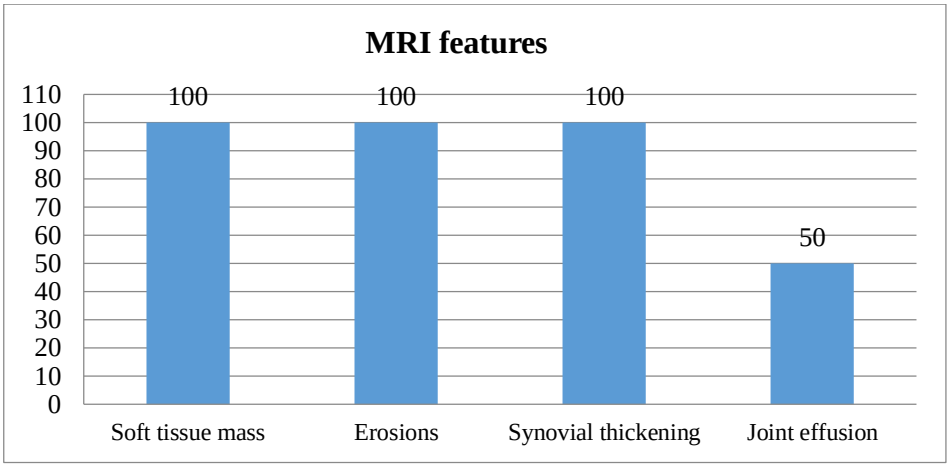



Fig 20 – Bar diagram showing MRI features of Gout

Sensitivity of imaging modalities in diagnosis of Gouty arthritis:

In our study, Plain radiograph, USG and MRI could diagnose 2 cases of Gouty arthritis based on radiological findings. On CT however only one case was diagnosed as Gout.



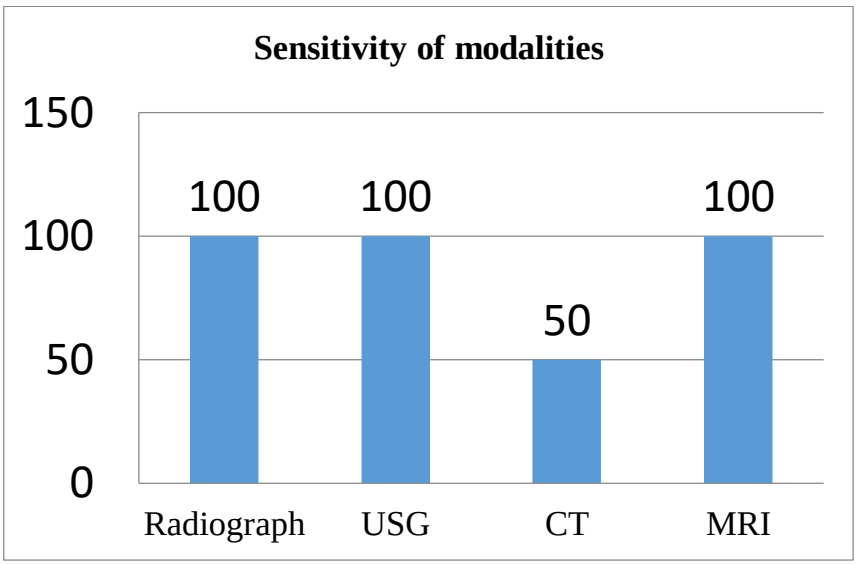



Fig 21 – Bar diagram showing sensitivity of imaging modalities in diagnosis of Gout

Radiographic features of synovial chondromatosis:

Calcified or ossified loose bodies along with joint space narrowing and osteophytes were seen in both the cases. Erosion was seen in one case of synovial chondromatosis in our study.

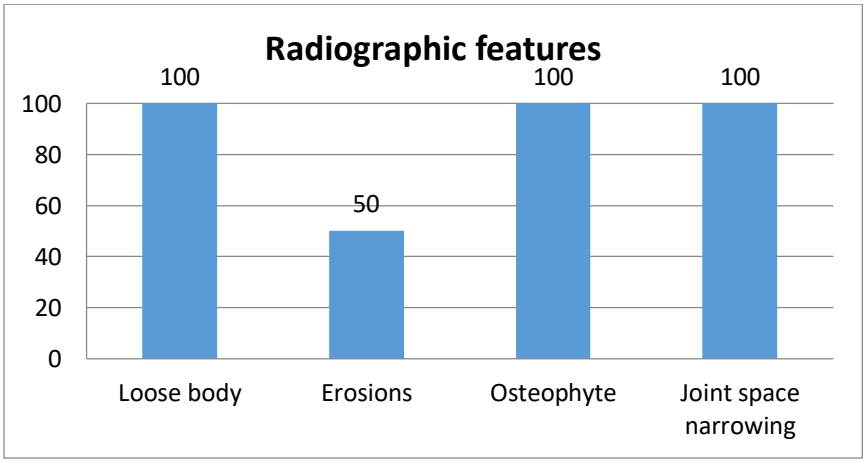



Fig 22 – Bar diagram showing Radiographic features of Synovial chondromatosis.

USG features:

Both the cases of synovial chondromatosis in our study showed calcified loose bodies and synovial thickening. Erosions were seen in one case.

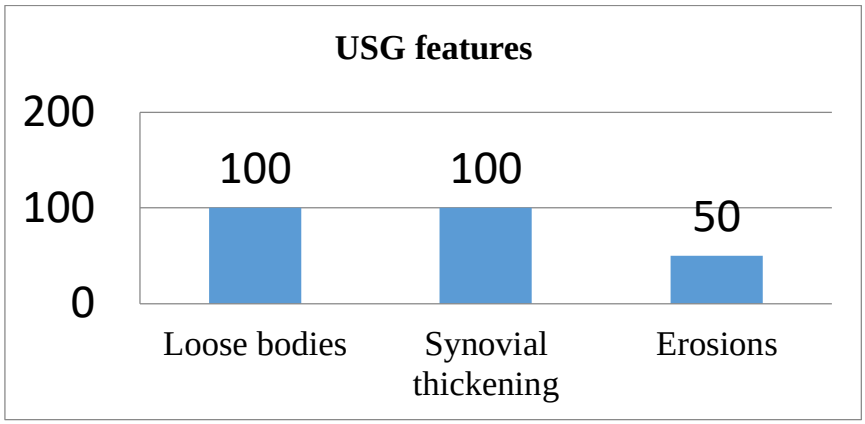



Fig 23– Bar diagram showing USG features of Synovial chondromatosis.

CT features:

Both the cases showed calcified loose bodies and osteophytes on CT.

MRI features:

On MRI both the cases showed loose bodies, erosions and synovial thickening. Joint effusion was seen in one case.

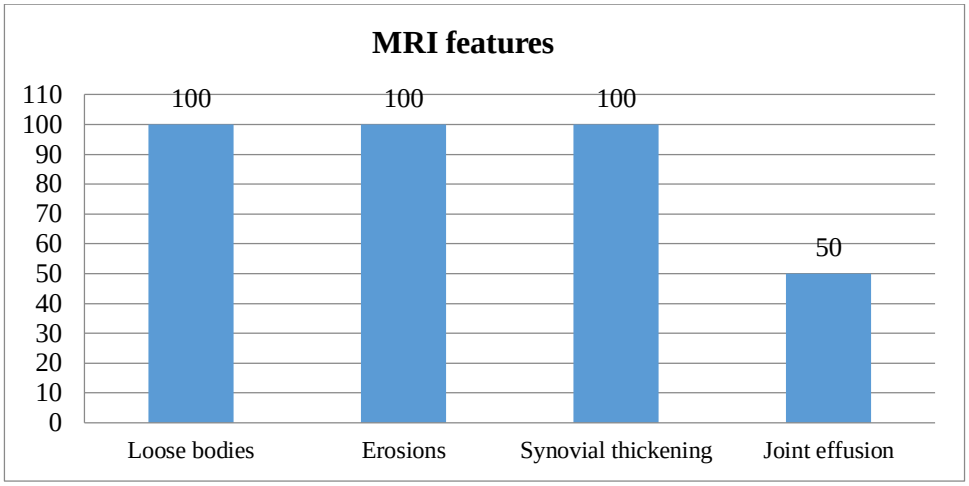



Fig 24 – Bar diagram showing MRI features of Synovial chondromatosis



Sensitivity of imaging modalities in diagnosis of Synovial chondromatosis

In our study, Plain radiograph, CTand MRI could diagnose both the cases of synovial chondromatosis.

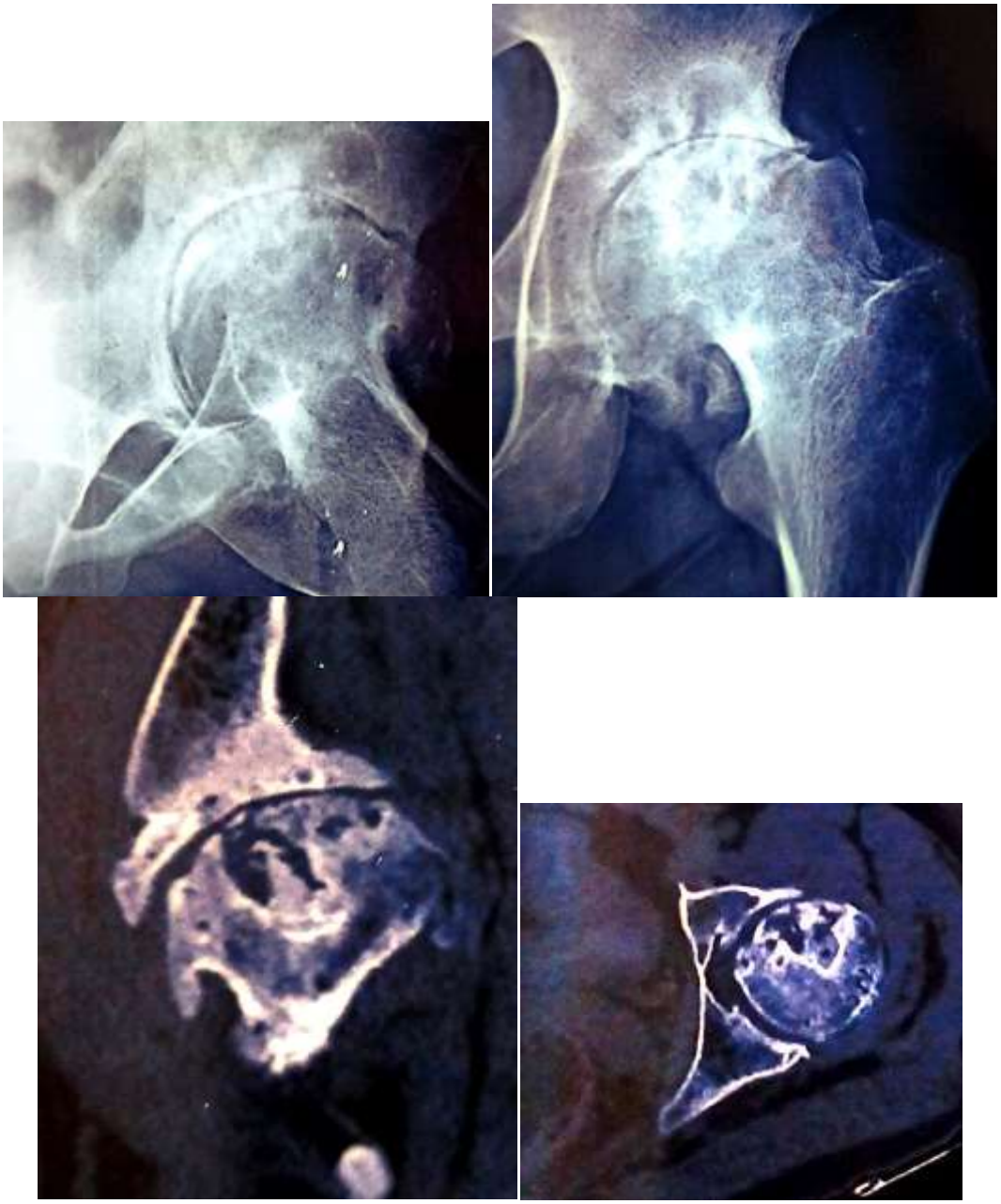
| Modality | Radiograph | Ultrasound | CT | MRI |
|---|---|---|---|---|
| No. of cases diagnosed | 2 | 1 | 2 | 2 |
| Sensitivity | 100 | 50 | 100 | 100 |

Table 10 – Sensitivity of imaging modalities



Fig 25: Plain radiograph, CT , MRI shows marginal osteophytes with joint space narrowing and subchondral changes.


Fig 26: USG shows Bakers cyst, articular cartilage thinning and osteophytes.



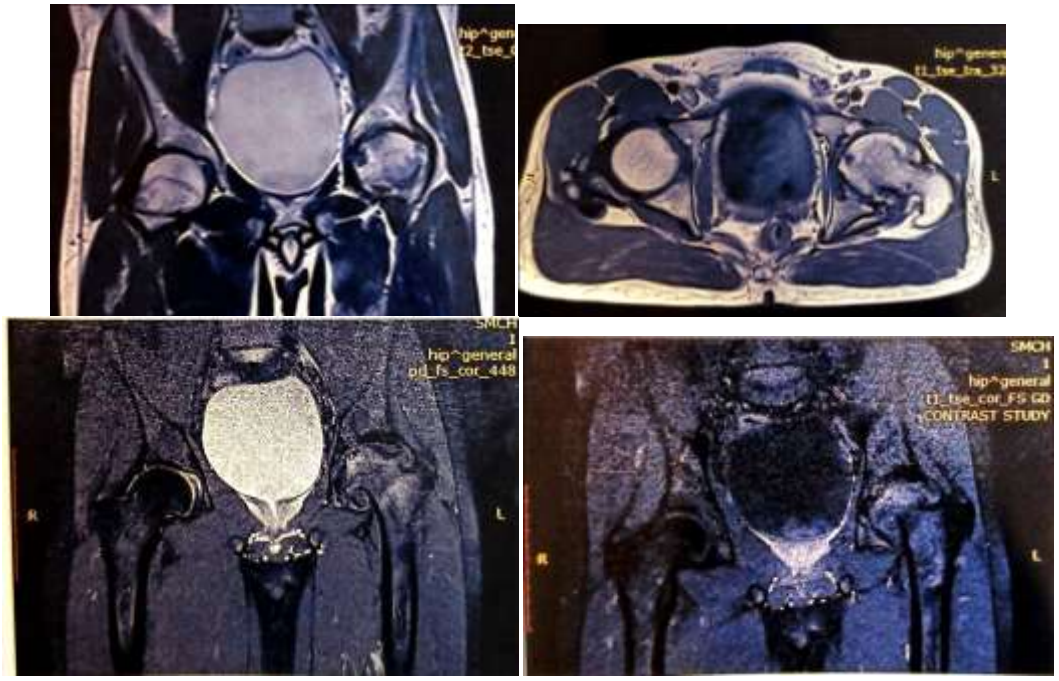
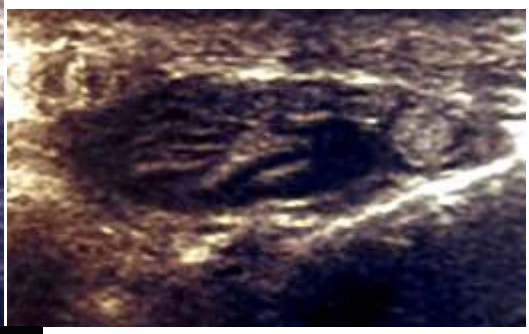





Fig 27: Avascular necrosis of hip: Plain radiograph shows subchondral sclerosis with subchondral collapse of femoral head, joint space narrowing and lateral acetabular marginal osteophytes. CT shows contoural irregularity, subchondral sclerosis and mild flattening of femoral head, joint space narrowing & lateral marginal osteophytes. MRI shows flattening of femoral head with irregular contour . Areas of T1& T2 hypointensities showing no post contrast enhancements , suggesting sclerosis, marrow edema showing post contrast enhancement with joint space reduction and marginal osteophytes.

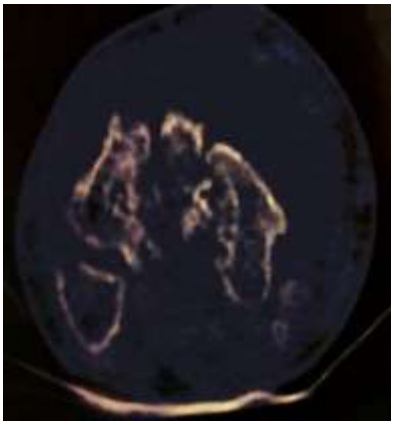
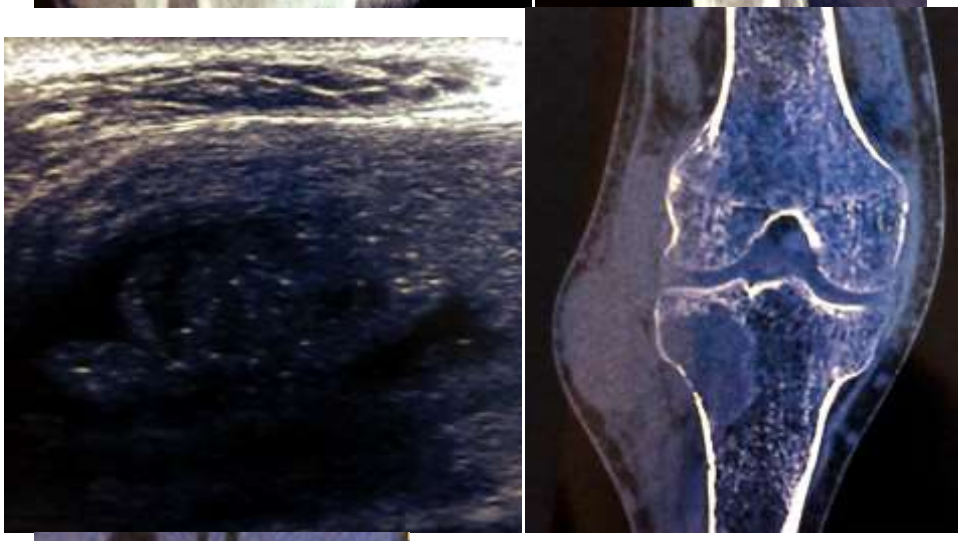
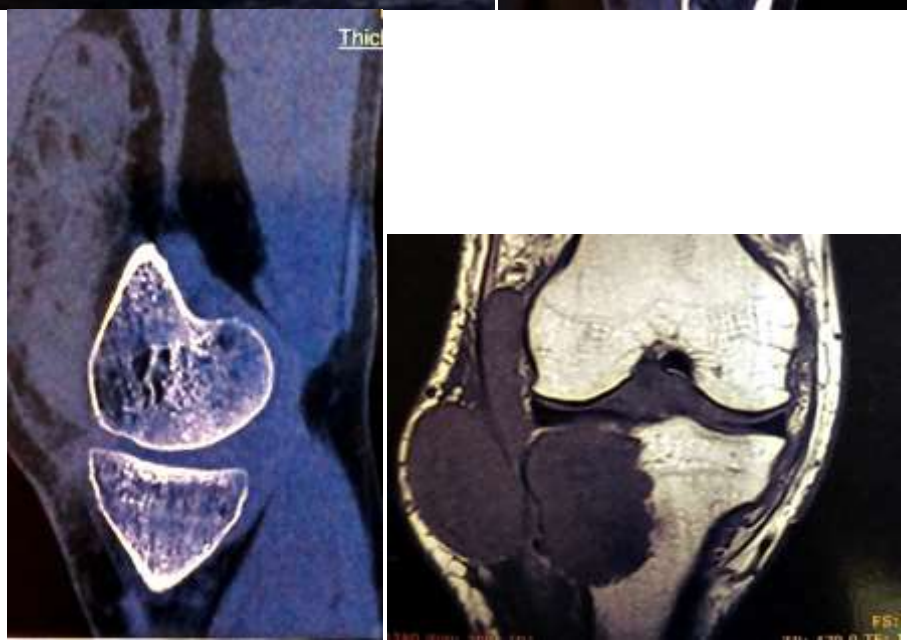




Fig 28: Inflammatory arthritis of the wrist joint: USG shows synovial thickening with hyperaemia. Fluid collection noted surrounding the extensor tendon. CT shows erosion, joint space reduction, osteopenia and subchondral changes. MRI shows joint space reduction, erosion, synovial thickening with post contrast enhancement. Bone marrow edema with enhancement noted at places.







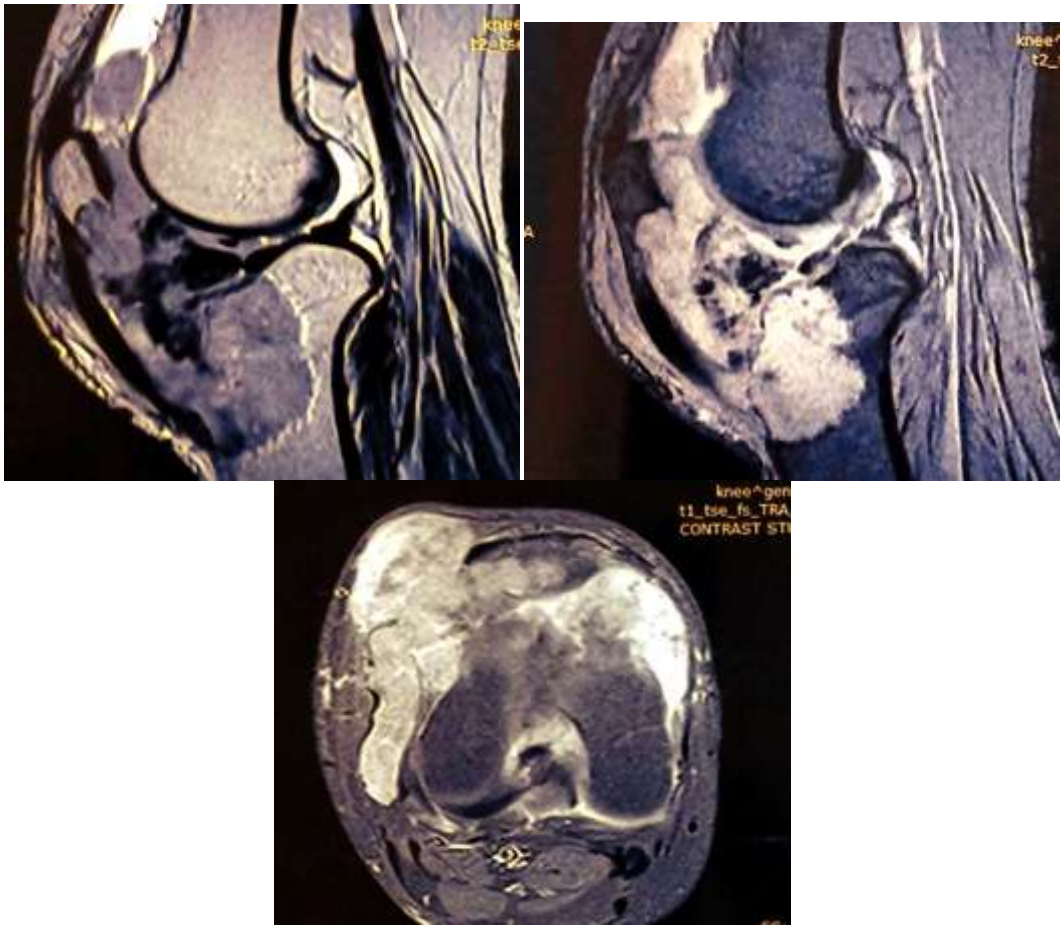




Fig 29: Pigmented villonodular synovitis of the knee: Plain radiograph shows swelling, erosions & subchondral changes. USG shows nodular synovial thickening with joint effusion. CT shows diffuse synovial thickening, erosions and joint effusion. MRI : T2 sagittal image shows synovial thickening with areas of T2 hypointensity. Areas of blooming on GRE. Diffuse synovial thickening with post contrast enhancement.

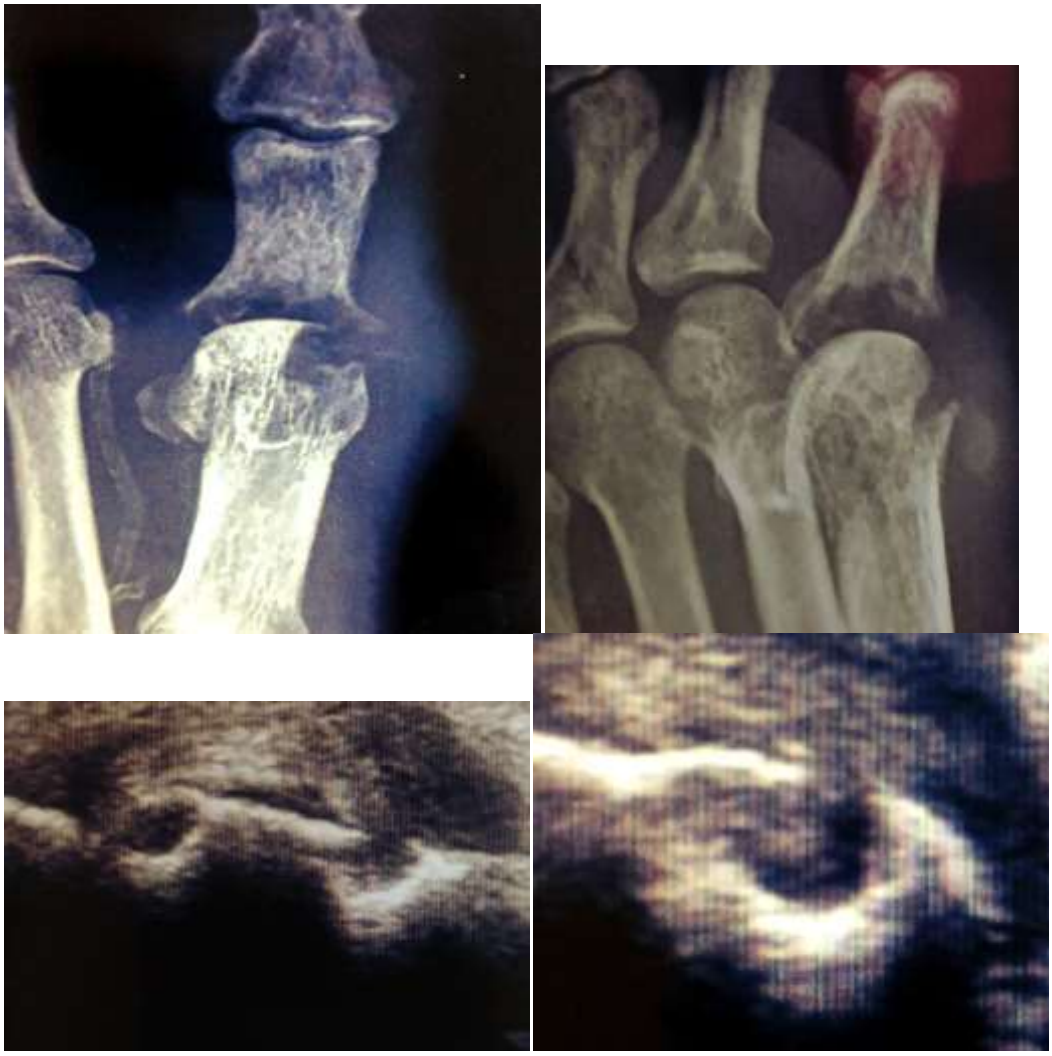
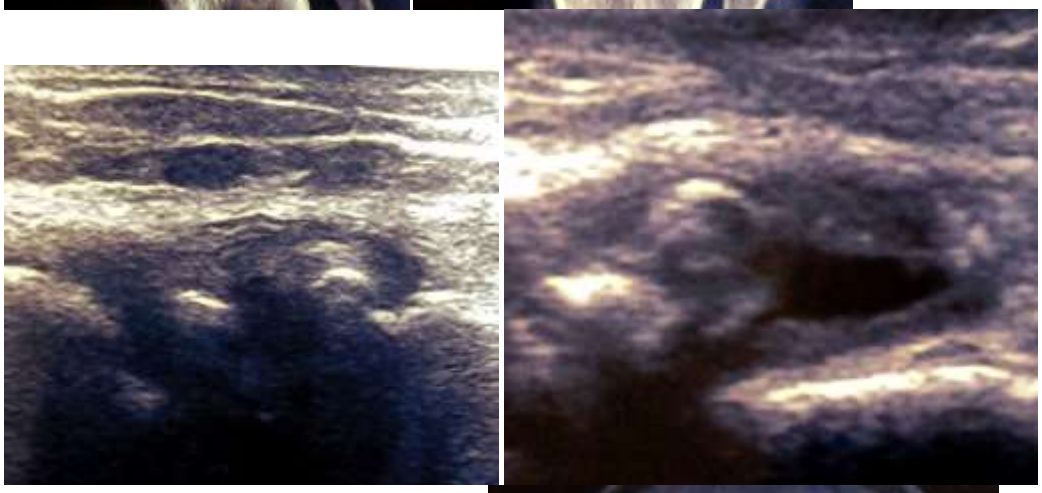
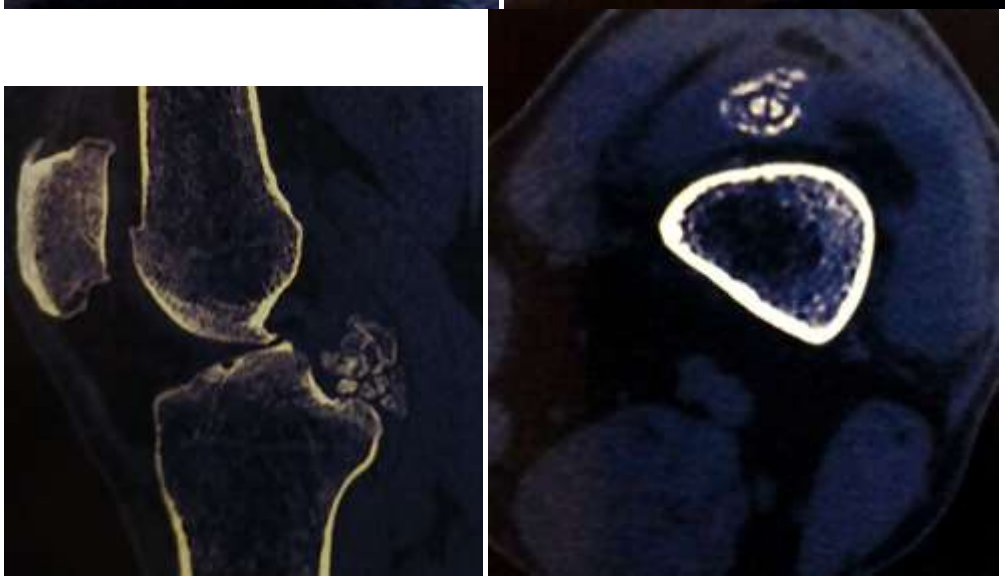




Fig 30: Gout involving first metacarpophalangeal joint: Radiograph shows punched out ( rat bite erosion) with soft tissue opacification and erosion. USG shows punched out erosions, synovial thickening and soft tissue tophi.







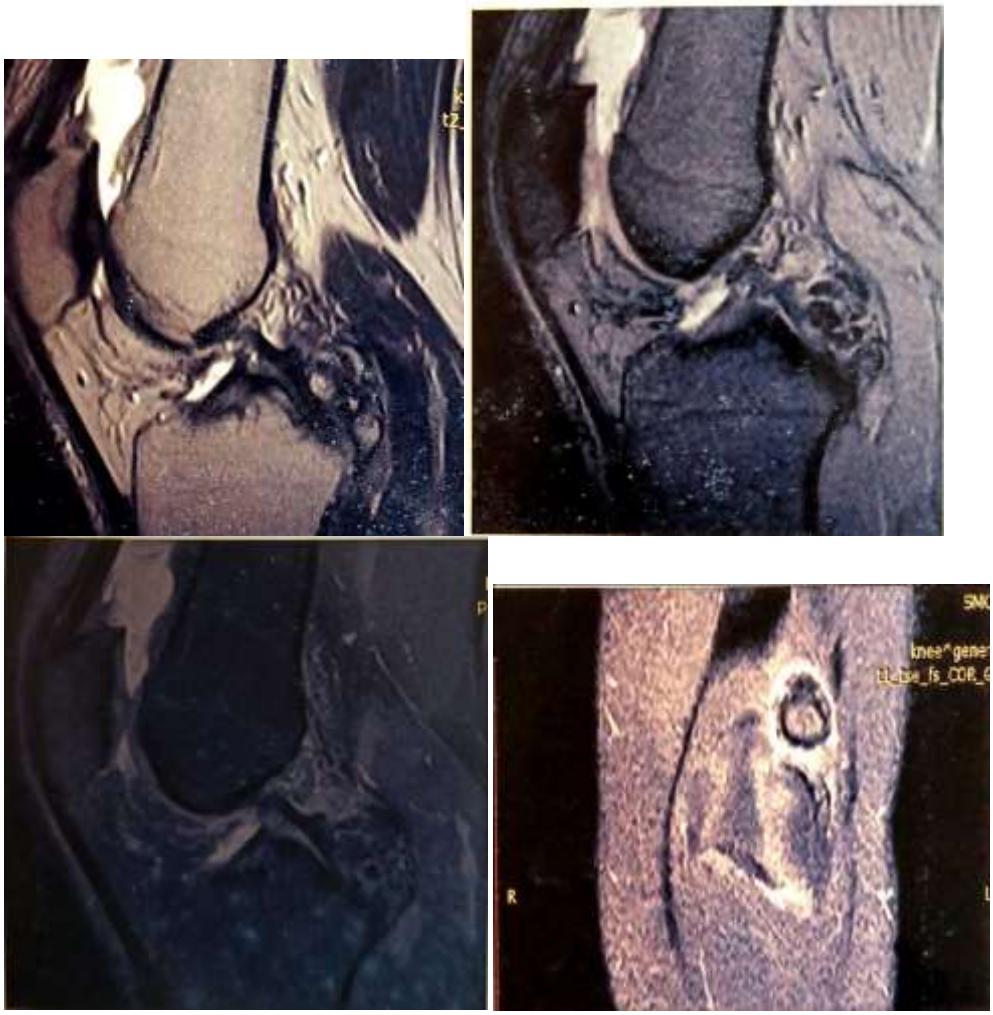


Fig 31: Synovial chondromatosis of Knee joint: Radiograph shows calcified loose bodies, joint space narrowing and marginal osteophytes. USG shows calcified loose bodies and synovial thickening. CT shows calcified loose bodies with joint effusion and osteophytes. MRI shows T1 and T2 hypointensities showing blooming on GRE with associated joint effusion and reactive synovitis.

**DISCUSSION**

Out of 37 patients with non-infective monoarticular arthropathy, most common pathology behind non-infective monoarticular arthropathy in our study was found to be osteoarthritis. Out of 37 patients 13 cases were diagnosed to be osteoarthritis. In our study males were more commonly affected than females. The most common age group seen was in the range of 20-40 years (69.6%). The most common joint involved was knee joint ( 46.7%).

Osteoarthritis

In our study, presence of osteophytes was the most common radiographic and CT finding in osteoarthritis seen in all the 13 cases. Radiograph diagnosed 10 cases and CT was able to diagnose osteoarthritis in all the cases. In a study by John Bedson et al[2] too find an association between joint pain and radiographic osteoarthritis found that osteophytes were the most common radiographic entity to cause joint pain and is highly sensitive (82.5%) but less specific (23.3%). On contrary joint space narrowing was less sensitive (38.3%) but more specific (82.9%). AP view with an

added lateral view gave a prevalence of pain in those with radiographic osteoarthritis to 80%.

Sensitivity of radiograph in diagnosing osteoarthritis in our study was 85%. Cittucini et al[3] reported osteophytes and joint space narrowing as the most significant radiographic changes in osteoarthritis with a sensitivity of 61% and specificity of 77.6. Brandt KD et al[4] reported that the radiographic diagnosis of osteoarthritis was made in 81% of cases in their study which focused more on joint space narrowing than osteophytes. Altman et al[5] included osteophytes, joint space narrowing and subchondral changes as the parameters for radiographic osteoarthritis in their study. Peat G et al[6] concluded that radiographic sensitivity of diagnosing osteoarthritis was 99% and specificity of 93%. Our study correlated with the previous studies.

On USG, osteophytes were seen in 9 cases out of 13 cases in our study and articular cartilage thinning was seen in 6 cases. Naredo et al[7] reported that effusion (46.7%), medial meniscus protrusion (61.1%) and Baker cyst (22.2%) were the principle findings in a case of osteoarthritis in their study. In our study out of the 13 cases of osteoarthritis, 10 cases were knee joint osteoarthritis where Baker cyst was seen in 4 cases and meniscal changes in 6 cases. Abraham et al[8] reported that effusion was seen in all cases of osteoarthritis. Synovial hypertrophy and Osteophytes on USG were in agreement with MRI in 79% and 75% cases respectively. Slimani al[9] reported osteophytes in86.5% of cases on USG.

In our study the most common MRI features were osteophytes (100%), joint effusion (100%) and articular cartilage thinning (100%). Joshi V et al[10] in their study on evaluating osteoarthritis by MRI and correlating it with the radiograph founded that osteophytes were seen in 100% cases, bone marrow oedema in 78.12% cases and subchondral changes in 62.50% cases. Boutry et al[11] reported 83% cases showing osteophytes on MRI, effusion and bone marrow oedema were noted in 100% cases. Bijen et al[12] concluded that MRI had a specificity of 90.1%-95.3% and sensitivity of 43.3-53.3%.

In our study, MRI had a higher sensitivity (100%) of diagnosing osteoarthritis when compared to other modalities which correlate with the studies done by Chan et al[13], Kawahara et al[14] and Beogard et al[15].Kawarah et al[14] in their study found that the sensitivity of diagnosing grade 3 and grade 4 osteoarthritis by MRI was 93.5% and 100% respectively.



Avascular necrosis

In our study, out 10 cases of AVN, hip joint was the most common site of involvement. Out of the 10 cases of AVN all the cases showed sclerosis, altered morphology of the involved segment (collapse, flattening, fissuring or contoural irregularity) and subchondral changes (collapse and air crescent sign following fracture). Degenerative changes (osteophytes, joint space reduction or subchondral cysts) were seen in 7 cases and neck widening in 4 cases. In a study conducted by Dunn et al[16] AVN was predominantly seen in males (76%) compared to females (24%). In their study the most common age group affected was in the range 26 – 59 years. In the study conducted by Diana Kamal et al[17] the maximum cases were in the range 30-50 years. Buckley et al[18] in their study had a age group ranged from 31 – 55 years. Buckley et al[18] and Marciniak et al[19] also found a male preponderance with 68% and 58% cases being males respectively .The above mentioned studies were comparable to our study. John Paul Jones et al[20] in their study found a female preponderance with 19 females

out of 32 cases which did not correlate to our study.

The most common finding on radiograph in our study was sclerosis with subchondral collapse, joint space reduction followed by flattening of femoral head. Mitchell et al[24] in their study found that the most common finding in AVN was sclerosis followed by mottling and flattening on radiograph. Subchondral changes were seen in most of the cases along with joint space reduction. Netam et al[21] and Beltran J et al[22] reported that the sensitivity of X- ray in detecting AVN to be 74.7% and 76% respectively. The sensitivity to detect stage III and IV AVN was 100% according to Beltran J et al[22]. In our study the sensitivity of plain radiograph in detecting AVN was 80%.

In our study all the 10 cases showed altered morphology in the form of flattening, fissuring, collapse or contoural irregularity on CT along with subchondral changes. Sclerosis was seen in 9 cases and osteophytes were seen in 7 cases. Mitchell et al[23] founded reactive sclerosis in 95% cases of AVN on CT and 38% of cases showed subchondral sclerosis. Stevens et al[24] stated that CT was superior to other modalities in detecting subchondral fractures. In their study 18 fractures were detected by CT, 12 on radiography and only 6 on MRI. Lee et al[25] in their study concluded that the sensitivity of CT in diagnosing AVN to be 55%.

The most common MRI finding of AVN in our study was altered morphology, altered marrow signal intensity and subchondral changes. Joint effusion was seen in 70% cases. Degenerative changes were seen in 70% cases. The sensitivity of detecting AVN by MRI in our study was 100%. According to a study conducted by Netam et al[21] the most common finding on MRI in a case of AVN is bone marrow oedema. Joint effusion was seen in 68.4% cases. Mitchell et al[23] in their study reported bone marrow oedema to be a early finding of AVN on MRI, while Iida et al[26] reported it to be associated to advanced cases of AVN ( stage III and IV). Huang et al[27] noted joint effusion in 92% cases, commonly in stage III. Marrow conversion was noted in 80% cases of AVN in a study done by Mitchell et al[23]. They also found the T2 double line in 80% of cases and later concluded that the T2 double line to be pathognomic of AVN. Zurlo et al[28] and Beverly G. Coleman et al[29] also had similar findings in their studies. Lang et al[30],Totty WG et al[31] and Beverly G. Coleman et al[29] reported that MRI had 100% sensitivity in diagnosing AVN according to their studies. Our study was comparable to the previous mentioned studies.

Inflammatory arthritis

Jeong H et al[94] analysed 171 patients in their study with chronic monoarthritis. A final diagnosis was established in 43.3% of cases (18.1% were RA, 13.5% were peripheral spondyloarthritis and 11.1% were behcet's disease). Most common joint involved was knee joint (41 cases).

In our study out of the 6 cases, 4 cases showed erosions by radiography, CT and MRI and 2 cases by USG. Synovitis was seen in all the cases by MRI and 83.3% cases by USG. In our study MRI could detect all the cases of inflammatory arthritis.

In a prospective 7 year follow up study by Scheel et al[32] radiography detected erosions in 4% cases, USG in 9% and MRI in 27% cases. On follow up there was a decrease in synovitis noted by USG and MRI. USG detected synovitis initially in 83% cases while MRI detected in 63% cases. They concluded that MRI was the most established imaging technique for early inflammatory changes in joints. In a study by Navalho et al[33], synovitis was seen in 86.7% cases of PIP joint by MRI and 53.3% cases by USG. Tenosynovitis was found in 86.7% cases on MRI compared to 50% cases on USG.MRI was more sensitive compared to USG. Wang

et al[34] reported that USG detected synovial proliferation in 15.4% cases, joint effusion in 10.4% cases, bone erosion in 5.1% cases and tendon sheath oedema in 9.5% cases of joints with inflammatory arthritis. On comparison MRI detected bone erosion in 4.1% cases, bone marrow oedema in 5.5% cases, and joint effusion in 6.1% cases, tendon sheath oedema and synovial proliferation in 7.7% of cases. Backhaus et al[35] concluded in their study that MRI was better for detecting erosions compared to USG. USG was good at detecting inflammatory soft tissue changes. Radiographs were not adequate in depicting erosions and soft tissue lesions.

According to the study done by Caldarola et al[36] USG diagnosed 36 cases of psoriatic arthritis and radiography diagnosed only 11 cases. Synovitis was noted in all cases in their study. Synovial hyperemia was noted in 29 cases (total 36 cases) on colour Doppler study. Adam et al[37] in their study reported that out of the 19 joints which showed abnormalities on radiography, MR showed joint effusion in 16, cartilage defects in 12 and thinned menisci with altered signal in 10. The study concluded that contrast enhanced MRI was very useful in differentiating normal from inflamed synovium and subchondral pannus from subchondral sclerosis. In their study out of 23 joints 19 joints showed subchondral cysts with two cases showing enhancement on post contrast study.

In our study we found 4 cases of PVNS, out of which two were localized and two were diffuse form of PVNS. All the cases involved the knee joint.

In their study 73.84% cases were knees and 18.14% cases were hips. The study conducted by Myers et al[38] showed two thirds of the cases involved knee joint.

In our study the most common finding on radiograph was soft tissue swelling and two cases out of the 4 cases (50%) showed erosions. According toMyers et al[38] the most common finding on radiograph was bone erosion or cyst formation which was seen in 54% of cases of diffuse PVNS and 20% cases of localized PVNS in their study. Cheng et al[39] in their study found that in knee joint, swelling and effusion were the only radiographic findings in PVNS. The most common MRI finding of PVNS in our study was thickened synovium with T1 and T2hypointensity and areas of blooming on GRE seen in all the 4 cases. In a study conducted by Myers et al[38] on MRI out of 115 cases synovial hypertrophy was seen in 94 cases, nodules in 65 cases, contrast enhancement in 106 cases and bone lesions in 12 cases. All cases were monoarticular except one. MRI diagnosed 83% cases in their study. Cheng et al[39] were of the same opinion that MRI was the imaging modality of choice for diagnosing PVNS. In their study, out of 23 cases 9 occurred in hip and 8 in knee. All the 9 hips showed subchondral erosions on radiography and joint space narrowing in 5 cases. MRI demonstrated multiple erosions in all the cases except in the cases where the knees were involved, bone marrow oedema in 10 cases and joint effusion in 7 cases. In all cases blooming on GRE was noted.

Our study was comparable to the studies mentioned above.

Gout

The most common radiographic and USG finding in our study was soft tissue tophi with erosions. According to Rettenbacher et al[40] plain radiography noted soft tissue opacification in 26% cases, bone erosions in 20% cases and osteophytes were noted in 5% cases. USG revealed bright stippled foci in 80%, bone erosions in 24%, hypervascularisation on doppler study in 94% cases. Most common joint was metatarso-phalangeal joint. USG had a sensitivity of 96% and specificity of 73%

in diagnosing gout while X ray was only 31% sensitive. On radiography, Gerster et al[41] found soft tissue thickening in all the 4 cases and bone erosions in 3 cases. Increased vascularity on doppler study was seen in 3 cases. Barthelemy et al[42] in a prospective radiographic evaluation found that the radiographic findings in a case of gout were visualization of tophi, erosions with sclerotic or overhanging margins and relative lack of degenerative disease. Radiographs detected 60% cases of gout. It was 77% for cases with foot involved. Strobl et al[43] the sensitivity of detecting gout by USG was 59.6%. Urate deposition was noted in only 11 patients out of 52 patients. In a study by Wright et al[44] , out of 78 cases 52 patients (67%) had erosions on USG and 19 erosions showed doppler activity. On X-ray 22 joints showed erosions. All the patients were males with mean age of 52 years.

Synovial chondromatosis

Sviland et al[45] in their report of 19cases with synovial chondromatosis, most common joint involved was knee. In our study the most common radiographic finding was calcified loose bodies, joint space narrowing and osteophytes. Türkmensoy et al[46] in their case report found that the pathognomic finding on radiograph for diagnosing synovial chondromatosis was multiple calcified loose bodies in the joint. On CT loose bodies along with erosions were seen.MRI revealed low T1 and high T2 with hypointense calcification in 77% cases, which was the most common pattern. The disease is usually monoarticular.Kim et al[47] found that out of 15 cases of synovial chondromatosis 12 had juxta articular loose bodies (80%), bone erosion in 8 cases and osteophyte in 7 cases. Juxta articular osteopenia and joint space narrowing was also noted. The most common finding on MRI was intra articular loose bodies with low signal intensity in all pulsed sequences with areas of hyperintensity on T2 (53% cases). In our study the most common MRI finding was loose bodies with synovial thickening and erosions. Serbest et al[48] and Gu H et al[49] in their case reports found similar manifestations of synovial chondromatosis on radiographs, CT and MRI. Go T et al[50] reported a case of synovial chondromatosis of the knee joint which showed neither calcification nor ossification on X- ray and CT. MRI showed a swollen supra patellar bursa with fluid and multiple nodules within the fluid which were low signal intensity compared to fluid on T2 weighted MRI. Contrast enhancement was noted in the periphery of the bursa however no synovial thickening was noted. The nodules within the synovial fluid did not enhance. On needle biopsy synovial chondromatosis was indicated. The nodules within the fluid were suspected to be unmineralized loose bodies.



**Conclusion**

There are various causes of monoarticular arthropathy, so a correct diagnosis and follow up is crucial for appropriate treatment. A delay can result in serious complications to the patient and finally might lead to death. Hence imaging plays a vital role in decreasing both mortality and morbidity of a patient with monoarticular symptoms.

Plain radiography is considered the basic first line investigation. In diagnosing joint effusions, soft tissue changes and synovial thickening USG had an excellent sensitivity. CT although has a definitive role, however radiation risks must be considered in its use. As MRI is both specific and sensitive , so it is imaging modality of choice for diagnosing a case of monoarticular arthropathy.

The aim of the present study was to evaluate the radiological findings of various monoarticular arthropathies of non-infective origin . MRI was the imaging modality of choice to evaluate a

case of monoarticular arthropathy of non-infective origin, Radiography, USG and CT plays an important supportive role.

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