

Bibliographic Cite	Literature Type	Level of Evidence	Purpose	Population	Intervention and Outcome Measures	Results/ Recommendations	Study Limitations
Chopra A, Grainger AJ, Dube B, et al. Comparative reliability and diagnostic performance of conventional 3T magnetic resonance imaging and 1.5T magnetic resonance arthrography for the evaluation of internal derangement of the hip. Eur Radiol. 2018;28(3):963-71.	Observational study	Moderate	To compare the diagnostic accuracy of conventional 3T MRI against 1.5T MR arthrography (MRA) in patients with clinical femoroacetabular impingement (FAI).	68 British symptomatic patients with clinical FAI	Sixty-eight consecutive patients with clinical FAI underwent both 1.5T MRA and 3T MRI. Imaging was prospectively analysed by two musculoskeletal radiologists, blinded to patient outcomes and scored for internal derangement including labral and cartilage abnormality. Interobserver variation was assessed by kappa analysis. Thirty-nine patients subsequently underwent hip arthroscopy and surgical results and radiology findings were analysed.	Both readers had higher sensitivities for detecting labral tears with 3T MRI compared to 1.5T MRA (not statistically significant $p=0.07$). For acetabular cartilage defect both readers had higher statistically significant sensitivities using 3T MRI compared to 1.5T MRA ($p=0.02$). Both readers had a slightly higher sensitivity for detecting delamination with 1.5T MRA compared to 3T MRI, but these differences were not statistically significant ($p=0.66$). Interobserver agreement was substantial to perfect agreement for all parameters except the identification of delamination (3T MRI showed moderate agreement and 1.5T MRA substantial agreement). Conventional 3T MRI may be at least equivalent to 1.5T MRA in detecting acetabular labrum and possibly superior to 1.5T MRA in detecting cartilage defects in patients with suspected FAI.	Study limitations include small study size and the assumption that the surgical findings at arthroscopy were the gold standard, although the two radiologists in the study were completely blinded to the results of the arthroscopy and the proportion proceeding to surgery, and the images were prospectively interpreted in a random order, there is a risk of inevitable detection bias towards a largely symptomatic patient population.
Crim J, Oserowsky A, Layfield LJ et al. Comparison of radiography and histopathologic analysis in the evaluation of hip arthritis. AJR Am J Roentgenol. 2019; 213(4):895-902.	single-center, retrospective, multi-reader	low	To establish the correlation of radiography findings with findings of gross and microscopic histopathologic analysis to assess the usefulness of radiography in preoperative assessment for hip arthroplasty.	Nine hundred fifty-three cases were eligible for the study. The radiographs were supine in 639 cases and standing in 314. The mean patient age was 60 years (range, 18–94 years). The indication for femoral head resection was almost always osteoarthritis, but fracture, avascular necrosis, tumor, and infection were also indications. Twelve cases were inflammatory or infectious arthritis rather than osteoarthritis, leaving 941 cases in which severity of osteoarthritis was assessed.	Radiology and pathology reports from 953 consecutive femoral head resections were reviewed to establish the correlation of radiography and pathology findings as used in routine clinical practice. In 83 cases MRI images were also available for review. Both radiologists and pathologists prospectively used a four-grade scale of absent, mild, moderate, or severe osteoarthritis. The grades established by radiologists and pathologists were compared by means of both the four-grade system and a simplified two-grade system of none-to-mild versus moderate-to-severe osteoarthritis.	Resection was performed for osteoarthritis in 941 cases and for infection, inflammatory arthritis, avascular necrosis, fracture, or tumor in the others. Radiographs showed severe osteoarthritis in 62.3% of patients and no or mild osteoarthritis in 17.7%. Observed agreement between radiology and pathology findings was 90% for both the four-grade and two-grade osteoarthritis scales. Findings on standing radiographs were more concordant with pathology results than findings on supine radiographs (odds ratio, 1.4). Observed agreement between radiography and MRI was 78%. There were significant discrepancies between radiography grade and pathology grade in 2.2% of cases. Observed agreement of MRI and pathologic analysis was 76% ($\kappa = 0.64$). The authors conclude that radiography findings are a reliable indicator of severity of osteoarthritis. This is important because previous studies have shown that patients with no or mild osteoarthritis are less likely to benefit from arthroplasty. If evidence of moderate or severe osteoarthritis is not present on radiographs, further investigation is warranted before proceeding to arthroplasty.	One potential limitation of the study was that histopathologic examination evaluated the femoral side of the hip and not the acetabular side. The most important limitation of the study was that authors studied only cases of arthritis in which hip pain was sufficiently severe and persistent to lead to femoral head resection. This introduced substantial selection bias, especially in cases of mild osteoarthritis. Most cases of mild osteoarthritis are treated conservatively, not with femoral head resection. Therefore, authors cannot generalize that the number of cases in which osteoarthritis was underestimated on the basis of radiographs in their population is equivalent to that in the general population.
Froerer DL, Khalil AZ, Metz AK, et al. Magnetic resonance imaging and magnetic resonance arthrography are both reliable and similar when measuring hip capsule thickness in patients with femoroacetabular impingement syndrome. Arthrosc Sports Med Rehabil. 2024; 6(2):100874.	Retrospective, multi-reader, diagnostic case series	low	To propose an accurate method of measuring hip capsular thickness in patients with femoroacetabular impingement syndrome and to compare the reliability of these measurements between magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA).	Inclusion criteria were: 1) diagnosis of FAIS and subsequent treatment with arthroscopy and 2) preoperative MRI or MRA. Exclusion criteria were: 1) any history of surgery in the measured hip and 2) contrast extravasation on MRA. A total of 85 patients and their advanced imaging were included. Mean patient age was 30.6 (\pm 11.9) years, and mean body mass index was 25.6 (\pm 4.9). Approximately 70% of the selected patients were female.	A previously established database of patients with FAIS was used to identify the candidates with preoperative MRI or MRA. Two reviewers independently examined preoperative imaging for 85 patients. Capsular thickness was measured in 12 standardized locations. Intraclass correlation coefficients (ICCs) were calculated using an absolute-agreement, 2 way random-effects model. Using the same method, 30 patients were randomly selected for repeat measurements by 1 reviewer following a washout period. Ten additional patients with preoperative MRI and MRA of the same hip were identified to compare measurements between modalities using paired samples t test.	ICCs for measurements on MRIs and MRAs using these proposed measurements to compare inter-rater reliability were 0.981 and 0.985. ICCs calculated using measurements by a single reviewer following a washout period for intrarater reliability were 0.998 and 0.991. When comparing MRI and MRA measurements in the same patient, t test for all pooled measurements found no difference between modality ($P = .283$), and breakdown of measurements by quadrant found no difference in measurements ($P > .05$), with the exception of the inferior aspect of the capsule on coronal sequences ($P = .023$). The authors conclude that, in patients with FAIS, both MRI and MRA have excellent reliability for quantifying hip capsular thickness. A difference in capsular thickness was found only when comparing MRI and MRA on inferior coronal aspects of the hip capsule, indicating interchangeability of these imaging modalities when measuring the clinically important aspects of the hip capsule.	Several limitations are noted to exist within this current study. First, the PACS system used for this study had several technological limitations when it came to creating small, precise measurements. Second, the study cohort was restricted to patients who underwent surgical intervention and did not include patients who were treated conservatively. Next, due to the lack of indications for patients to obtain both MRI and MRA of the same hip without surgical intervention in between, the measurements for direct comparison of these imaging modalities were underpowered. Finally, the authors note that their 12-point capsular thickness measurement protocol only demonstrates that measuring the capsule in these areas is reliable, reproducible, and comparable on MRI and MRA. They state that they do not make any clinical inferences in this study and do not know if all of the regions are clinically important to measure.
Goldsmith C, Cheng J, Mintz D, Moley P. Correlation of femoral version measurements between computed tomography and magnetic resonance imaging studies in patients presenting with a femoroacetabular impingement-related complaint. J Hip Preserv Surg. 2022; 9(4):219-224.	Retrospective, multi-reader study	low	To correlate MRI and CT femoral version measurements in patients presenting with a femoroacetabular impingement (FAI) -related complaint.	Patients who were 18-35 years old, presented with an FAI-related complaint and had both CTs and MRIs of the hip with views of the knees were included. An FAI-related complaint can be defined as any patient who presented to a hip preservation clinic with a suspected FAI diagnosis and underwent further radiographic imaging to determine the source of their pain. Patients 35 years and older were excluded. Patients with osteoarthritis were also excluded. A total of 58 patients were included in the study, with a mean age of 25.2 (\pm 5.1) years, and 36 (62%) were female.	Femoral version on CT and MRI was measured on PACS using the MRI and CT axial methods. Measurement methodologies for CT and MRI were the same. Measurements were conducted by three individual raters. Identical slice levels across all images (coronal, axial pelvis and femoral condyle) were used among reviewers.	Femoral version averaged $6.1^{\circ} \pm 11.8^{\circ}$ on CT and $6.5^{\circ} \pm 10.8^{\circ}$ on MRI. A strong positive correlation was reported between the two imaging modalities ($r: 0.81$; $P < 0.001$). Inter-rater reliability among the three reviewers was excellent and statistically significant for measurements on both MRI [intraclass correlation coefficient (ICC): 0.95; 95% CI: 0.85, 0.99; $P < 0.001$] and CT (ICC: 0.97; 95% CI: 0.92, 0.99; $P < 0.001$). Our findings suggest that MRI is a sufficient method for measuring femoral version to determine disease etiology and treatment progression. That authors conclude that, to avoid exposing patients to ionizing radiation, physicians should not obtain CT scans to evaluate femoral version.	The patient population was between the ages of 18 and 35 years old, limiting the generalizability of the results to the pediatric and older adult population. Additionally, due to the length of time required to complete an MRI, the effects of motion would be most profound in MRI, possibly skewing results. Lastly, while every effort was made to ensure patient positioning was the same between subjects, there may be some variability in patient alignment, affecting the results.

Haims AH, Wang A, Yoo BJ, Porrino J. Negative predictive value of CT for occult fractures of the hip and pelvis with imaging follow-up. Emerg Radiol. 2021; 28(2):259-264.	Retrospective Study	Low	To determine the negative predictive value of multidetector CT for radiographically occult fracture of the hip or pelvis in an elderly population presenting to the emergency department.	A total of 257 patients, age > 65, with suspected fracture were identified over a 5-year period with negative radiographs acquired in the ED followed by an index CT of the hip/pelvis within 24 h. Patients with hardware in the region of interest were excluded.	Follow-up imaging was reviewed by 2 musculoskeletal radiologists for the presence of fracture to determine the performance of the index CT. The electronic medical record was used to exclude the possibility of intervening trauma between the time of the index CT and follow-up imaging.	There were 39 cases with follow-up imaging performed within 6 weeks of the negative index CT, and 42 with follow-up imaging within 6 weeks to 18 months of the negative index CT. Eight of 81 patients demonstrated a fracture on follow-up imaging, with 3 of 8 involving the femoral neck or intertrochanteric femur. The negative predictive value of the index CT for the detection of a radiographically occult hip or pelvic fracture was 90.1%. If considering only surgically relevant fractures (femoral neck and intertrochanteric fractures), the negative predictive value improved to 96.3%. The authors conclude that CT for occult hip fractures has a high negative predictive value but there are cases not detected with surgical implications.	Several limitations are noted. First, there were 56 patients with negative index CTs who did not have imaging follow-up thereafter. Of these 56, 35 had clinical follow-up with a physical examination documented in the electronic medical record within 6 weeks after the initial emergency department visit. These patients were not incorporated into our negative predictive value calculations as clinical follow-up without imaging is inherently less reliable. Second, without acute MRI follow-up after the index CT, fractures could therefore be potentially overlooked using follow-up CT and radiography to measure performance. Lastly, authors relied on the electronic medical record and PACS to determine if interval trauma occurred between the time of the index CT and follow-up imaging.
Hu LB, Huang ZG, Wei HY, et al. Osteonecrosis of the femoral head: Using CT, MRI and gross specimen to characterize the location, shape and size of the lesion. Br J Radiol 2015; 88:20140508.	Prospective Study	Low	The objectives of this study are (1) to investigate the accuracy of using CT to capture the size, location, shape and spatial structural relationship of the necrotic lesion by comparing the coronal CT with coronal MR images and findings from coronal sectional gross specimens; and (2) to evaluate the accuracy of using CT to measure necrotic lesion volume, using the measurement from MR images and gross specimen as references.	A total of 23 patients, treated from January 2006 to December 2012 were enrolled, including 16 males and 7 females, with a mean age of 36.5 years (range, 28-52 years). Inclusion criteria for patients were (1) undergone hip arthroplasty owing to late stage osteonecrosis of the femoral head (ONFH); (2) agreed to participate in study and provide signed informed consent.	Coronal CT and MRI scans were performed on femoral head specimens from patients who had undertaken hip arthroplasty owing to ONFH. The results were compared with findings from coronal sectional gross specimens. Two radiologists independently measured the volume of necrotic lesions from CT and MR images using computer software, and the results were averaged. The volume of specimens' necrotic lesion was measured using the water displacement method.	There was a high degree of consistency between CT, MRI and the coronal sectional gross specimen on the location, shape and spatial structure of lesions. Differences of the lesion volume measured from CT and MR images were not statistically significant between two radiologists. The necrotic lesion volumes measured from CT and MR images and gross specimens were 22.07 +/- 5.35, 22.21 +/- 5.15 and 21.12 +/- 4.96 cubic cm, respectively, and the differences were not statistically significant (F = 0.396; p = 0.674). CONCLUSION: For patients with ONFH in Association Research Circulation Osseous stage III or above, CT and MRI can accurately display the characterization of lesion.	This study has several limitations: (1) we used the lesion volume measured from coronal sectional gross specimen as the gold standard to evaluate the feasibility and accuracy of CT and MR images in measuring the lesion volume. Since only patients at late stage of ONFH undergo hip replacement surgery, there was no ARCO stage II case in this study. (2) We used water displacement method to measure lesion volume from gross specimen. Underestimation was possible if water permeates into the cancellous bone. (3) This study was conducted in vitro. The signal, density and intensity of CT and MR images of femoral head may be different from that obtained in vivo.
Neiman, M, Halshok Neiman, O, Aharoni, D, et al. Magnetic resonance arthrography of the hip: prevalence of diagnoses not suspected by the referring physician and correlation with clinical examination and pain score. Acta Radiol. 2016;57(5):595-601	Retrospective Study	Low	To evaluate the prevalence of non-suspected pathologies revealed by hip MRA and correlate them to physical examination/pain level	All hip MRAs (2011-2013) were retrospectively evaluated for intra- and extra-articular pathologies in consensus by two readers.	A clinical score (0-7)/pain score (0-10) was calculated for each patient based on orthopedic test results extracted from referral forms/a telephone questionnaire. Patients were divided into four groups according to MRA findings: intra-articular expected (targeted) pathology only; intra-articular targeted and additional non-targeted (unexpected) pathology; non-targeted pathology; and no pathology. Pathologies prevalence/clinical score/pain score were compared between the groups.	A total of 229 MRAs were included (127 men, 102 women; mean age, 36.5+/-14.17 years): 111(48.4%) patients had solely intra-articular targeted pathology. Significant non-targeted pathologies were detected in 76 (33%) patients (targeted and non-targeted, 51; non-targeted only 25). No significant pathology was detected in 42 patients (18%). Mean physical examination score was 2.77+/-1.77, range 0-7. There was no significant difference or correlation (r=0.017, P=0.804) between the clinical scores of the different MRA pathology groups. Pain score (143 patients) was significantly higher in the non-targeted pathology group compared to the targeted and non-targeted group (P=0.04) and to the no pathology group (P=0.04). There was no correlation between the physical examination score and the pain score (r=0.017, P=0.804). CONCLUSION: Unsuspected non-targeted pathologies were detected in 33% of hip MRA. Physical examination/pain level could not differentiate between patients.	Retrospective design
O'Sullivan GJ, Carty FL, Cronin CG. Imaging of bone metastasis: An update. World J Radiol. 2015; 7(8):202-211.	Review	Low	Briefly review the current understanding of the biological mechanisms through which tumors metastasize to bone and describe the available imaging methods to diagnose bone metastasis and monitor response to treatment.	N/A	N/A	Among the various imaging modalities currently available for imaging skeletal metastasis, hybrid techniques which fuse morphological and functional data are the most sensitive and specific, and positron emission tomography (PET)/computed tomography and PET/magnetic resonance imaging will almost certainly continue to evolve and become increasingly important in this regard.	N/A
Saied AM, Redant C, Anthonissen J, et al. Conventional versus direct magnetic resonance imaging in detecting labral lesions in femoroacetabular impingement - a retrospective multicenter study. Acta Orthop Belg. 2019; 85(1):100-106.	multi-center, retrospective, single-reader	low	To assess the reliability of Direct Magnetic Resonance Arthrography (MRA) and Conventional Magnetic Resonance Imaging (MRI) in diagnosing labral lesions in patients with symptoms of femoroacetabular impingement (FAI).	Only patients who received magnetic resonance imaging prior to surgery were included in the analysis. Additional inclusion criteria for this study were anterior hip pain, positive impingement test and radiological signs of FAI. The exclusion criteria were radiological signs of degenerative or dysplastic hip, external tendon pathology, history of open surgery and age above 60 or below 22 years of age. Within these constraints a total of 490 hips in 482 patients were selected for further statistical analysis. Mean age of patients was 39.5 years (range 22 - 60 years).	Imaging and surgical data (n=490) were retrospectively collected from 5 high-volume centers providing arthroscopic treatment of FAI patients. Preoperative magnetic resonance imaging findings were compared with the actual surgical findings regarding labral condition in order to assess the effectiveness of MRI and MRA in identifying the presence of labral tears in patients with FAI.	Labral tears were identified in 96 of 182 hips (52.7%) on MRI. The location of the labral tear was described as anterior-superior (AS) in 89 hips, anterior-inferior (AI) in 3 hips, posterior-superior (PS) in 3 hips, no posterior-inferior (PI) locations and multiregional in 1 hip. MRI had a sensitivity of 66.9%, a positive predictive value of 90.6%, a specificity of 82.6%, a negative predictive value of 50.0%, and an accuracy of 71.4% for the detection of labral tears. Labral tears were identified in 224 of 308 hips (72.7%) on MRA. The location of the labral tear was described as anterior-superior (AS) in 203 hips, anterior-inferior (AI) in 5 hips, posterior-superior (PS) in 3 hips, posterior-inferior (PI) in 1 hip and multiregional in 12 hips. MRA had a sensitivity of 74.4%, a positive predictive value of 85.7%, a specificity of 36.0%, a negative predictive value of 21.4%, and accuracy of 68.2% for the detection of labral tears	As it is a retrospective study, a control group of both absence of FAI or asymptomatic FAI could not be included. Protocols of MRI and MRA of different centers are not checked for reliability between different reporters. In this study 1.5 T was used for magnetic resonance while in the literature 3 T is mostly used. It is not clear what the effect of this difference may be on the results.