

**Chronic Hip Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Taljanovic MS, Hunter TB, Fitzpatrick KA, Krupinski EA, Pope TL. Musculoskeletal magnetic resonance imaging: importance of radiography. <i>Skeletal Radiol</i> 2003; 32(7):403	13	1,002 patients 1,030 MSK MRI studies	To determine the usefulness of radiography for interpretation of musculoskeletal (MSK) MRI studies.	Radiographs are important, and sometimes essential, initial complementary study for reading of MSK MRI examinations. Recommended that radiographs are available when MSK MRI studies are interpreted.	2
2. Newberg AH, Newman JS. Imaging the painful hip. <i>Clin Orthop Relat Res</i> 2003; (406):19-28.	12	N/A	A review of the changes in the imaging algorithm for hip pain that have resulted from the advent of MRI and MRA.	By combining conventional MRI with capsular distention afforded by arthrography, MRA has become the imaging examination of choice for disorders of the acetabular labrum and for the evaluation of articular cartilage at the hip.	4
3. Bancroft LW, Peterson JJ, Kransdorf MJ. MR imaging of tumors and tumor-like lesions of the hip. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):757-774.	12	N/A	To review the role of MRI in the diagnosis of tumors and tumor-like lesions of the hip.	Radiographs can depict the extent of disease; any characteristic calcifications; and osseous changes. MRI is now the preferred imaging modality of choice for evaluating osseous and soft-tissue masses of the hip by providing information for diagnosis and staging. The MRI signal characteristics and enhancement patterns of malignant and benign hip tumors permit specific diagnoses in some cases. Synovial-based tumor-like processes of the hip can be characterized by MR signal characteristics. MRI can also serve to exclude underlying osseous or soft-tissue tumors when radiographs display aggressive features of tumor-like processes.	4
4. Beltran J, Herman LJ, Burk JM, et al. Femoral head avascular necrosis: MR imaging with clinical-pathologic and radionuclide correlation. <i>Radiology</i> 1988; 166(1 Pt 1):215-220.	9	49 patients 85 hips	Retrospective study comparing bone scans with MRI for diagnosis of avascular necrosis (AVN) of the femoral head.	MRI had higher sensitivity of 88.8% and specificity of 100% compared to bone scans (sensitivity of 77.5%, specificity of 75%). Bone pressure measurement was most sensitive (92%) but least specific (57%).	2
5. Beltran J, Knight CT, Zuelzer WA, et al. Core decompression for avascular necrosis of the femoral head: correlation between long-term results and preoperative MR staging. <i>Radiology</i> 1990; 175(2):533-536.	13	24 patients 34 hips 2 observers	Retrospective study. Follow-up study on patients who had core decompression of the femoral head for AVN to assess the potential correlation between the extent of AVN, as determined with preoperative MRI, and the occurrence of collapse.	MR estimation of the extent of femoral head involvement with AVN may be useful in predicting which femoral heads will collapse shortly after core decompression.	3
6. Beltran J, Opsha O. MR imaging of the hip: osseous lesions. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):665-676, vi.	12	N/A	To review role of MRI in the diagnosis of hip osseous lesions.	Different conditions involving the hip joint and adjacent bony structures can be well evaluated using MRI, with or without contrast material. Hip trauma and AVN are the most frequent indications.	4

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7. Bencardino JT, Mellado JM. Hamstring injuries of the hip. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):677-690, vi.	12	N/A	To review role of MRI in the diagnosis of hamstring injuries of the hip.	MRI may provide accurate information with regard to the site, grade, and prognosis of hamstring lesions.	4
8. Bogost GA, Lizerbram EK, Crues JV, 3rd. MR imaging in evaluation of suspected hip fracture: frequency of unsuspected bone and soft-tissue injury. <i>Radiology</i> 1995; 197(1):263-267.	13	70	Retrospective study to determine the frequency of unsuspected pelvic fracture and soft-tissue injury in patients evaluated with MRI.	80% of patients had bone or soft-tissue abnormalities. Occult femoral and pelvic fractures were demonstrated in 37% and 23% of patients, respectively. Soft-tissue abnormalities were seen in 74% of patients. When a proximal femoral fracture was not present, MRI revealed a 27% frequency of occult pelvic fracture and a 50% frequency of bone or soft-tissue abnormality.	2
9. Bordalo-Rodrigues M, Rosenberg ZS. MR imaging of the proximal rectus femoris musculotendinous unit. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):717-725.	12	N/A	To discuss the role of MRI in the diagnosis of the proximal rectus femoris musculotendinous unit.	MRI is a helpful for diagnosing and grading proximal rectus femoris injuries. MRI is also valuable in predicting the length of recovery and rehabilitation time of musculotendinous strains and in presurgical planning when resection of a chronic hematoma, deep scar tissue, or a pseudocyst is contemplated.	4
10. Bredella MA, Stoller DW. MR imaging of femoroacetabular impingement. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):653-664.	12	N/A	To discuss the role of MRI in the diagnosis of femoroacetabular impingement (FAI), a common cause of osteoarthritis in the hip.	MRI and MRA are accurate modalities to demonstrate acetabular labral disease and adjacent cartilage damage as well as the subchondral cysts and synovial herniation pits associated with impingement. MRI is also able to detect underlying subtle anatomic variations of the femoral head-neck junction and acetabulum associated with FAI.	4
11. Dillon JE, Connolly SA, Connolly LP, Kim YJ, Jaramillo D. MR imaging of congenital/developmental and acquired disorders of the pediatric hip and pelvis. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):783-797.	12	N/A	To review the role of MRI in the diagnosis of congenital/developmental and acquired disorders of the pediatric hip and pelvis.	MRI provides an accurate method of evaluating the hip and pelvis. The soft-tissue resolution of MRI is superior to CT and is vital for purposes of imaging cartilage.	4
12. Dwek J, Pfirrmann C, Stanley A, Pathria M, Chung CB. MR imaging of the hip abductors: normal anatomy and commonly encountered pathology at the greater trochanter. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):691-704, vii.	12	N/A	To review the anatomy and pathologic findings of the osseous and soft-tissue anatomy of the greater trochanter.	A detailed knowledge of anatomy is useful in MRI interpretation.	4

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13. Khanna AJ, Yoon TR, Mont MA, Hungerford DS, Bluemke DA. Femoral head osteonecrosis: detection and grading by using a rapid MR imaging protocol. <i>Radiology</i> 2000; 217(1):188-192.	9	179 hips 92 patients 2 observers	To assess accuracy of limited (shortened) MR examination for detection and grading of osteonecrosis of the femoral head by comparing with full hip examination.	Limited MR study comparable in accuracy to more conventional study for detection and grading of osteonecrosis.	2
14. Koulouris G, Morrison WB. MR imaging of hip infection and inflammation. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):743-755.	12	N/A	To discuss the role of MRI in the diagnosis of hip infection and inflammation.	MRI is recommended for demonstrating the manifestations and sequelae of the infective and inflammatory conditions common to the hip. Combining the clinical history and results and other imaging modalities yields a higher degree of specificity.	4
15. Lafforgue P, Dahan E, Chagnaud C, Schiano A, Kasbarian M, Acquaviva PC. Early-stage avascular necrosis of the femoral head: MR imaging for prognosis in 31 cases with at least 2 years of follow-up. <i>Radiology</i> 1993; 187(1):199-204.	13	27 patients 31 cases of osteonecrosis	To define quantitative parameters at MRI that reflects the size and location of early-stage osteonecrosis in an attempt to correlate those parameters with long-term behavior of the disease.	Measurement of percentage of weight-bearing surface involved by osteonecrosis functioned as a reasonably accurate predictor of both worsening symptoms and collapse.	3
16. Lang P, Jergesen HE, Moseley ME, Block JE, Chafetz NI, Genant HK. Avascular necrosis of the femoral head: high-field-strength MR imaging with histologic correlation. <i>Radiology</i> 1988; 169(2):517-524.	14	6	To correlate the MR appearance and histology of femoral head specimens with documented osteonecrosis.	Intermediate weighted images help in distinguishing necrotic degraded marrow with amorphous intratrabecular debris from viable mesenchymal repair tissue.	4
17. Malizos KN, Zibis AH, Dailiana Z, Hantes M, Karachalios T, Karantanas AH. MR imaging findings in transient osteoporosis of the hip. <i>Eur J Radiol</i> 2004; 50(3):238-244.	13	20	A prospective study of patients with acute hip pain whose clinical and radiographic findings were not relevant to AVN. Authors described the MRI findings including perfusion imaging, in association with the course of acute bone marrow oedema syndrome, in a group of patients with acute hip pain and a final diagnosis of transient osteoporosis of the hip.	The acute bone marrow oedema syndrome MRI pattern varies and is most commonly appearing on radiographs as osteopenia. Absence of subcondral lesions, delayed peak enhancement of the abnormal marrow on perfusion images, and sparing of subchondral zone from marrow oedema are MRI findings highly correlated to transient osteoporosis of the hip.	3
18. Mellado JM, Bencardino JT. Morel-Lavallee lesion: review with emphasis on MR imaging. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):775-782.	12	N/A	To discuss the role of MRI in the diagnosis of Morel-Lavallee lesion.	MRI is recommended in the assessment of Morel-Lavallee lesions in the hip region.	4

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19. Mitchell DG, Rao VM, Dalinka MK, et al. Femoral head avascular necrosis: correlation of MR imaging, radiographic staging, radionuclide imaging, and clinical findings. <i>Radiology</i> 1987; 162(3):709-715.	9	39 patients 56 hips	To correlate MR appearance with radionuclide bone scan and clinical presentation and course.	Fractures complicating AVN were seen in 28 (50%) of 56 radiographs (radiographic stages III-V). With long repetition (TR) and echo delay (TE) times, a characteristic “double line sign” consisting of high signal intensity inside a low-intensity peripheral rim was seen in 45 lesions (80%). The central region within the rim was isointense with marrow fat on both short and long TR and TE images in 20 (71%) of 28 lesions uncomplicated by fracture (stages I-II) but in only four (14%) of 28 stage III-V lesions (P<.001). Symptoms were least severe in lesions isointense with fat and most severe in lesions with low-signal central regions at short and long TRs and TEs. The peripheral double line sign on long TR/TE images may add specificity to the diagnosis of AVN by MRI.	2
20. Nelson EN, Kassarian A, Palmer WE. MR imaging of sports-related groin pain. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):727-742.	12	N/A	To discuss the role of MRI in the diagnosis of sports-related groin pain.	MRI of the hip and pelvis can provide a prompt and specific diagnosis, enabling early treatment.	4
21. Shabshin N, Rosenberg ZS, Cavalcanti CF. MR imaging of iliopsoas musculotendinous injuries. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):705-716.	12	N/A	To discuss the role of MRI in the diagnosis of the iliopsoas musculotendinous injuries.	MRI is most accurate for diagnosing nondynamic diseases of the iliopsoas compartment as well as for ruling out other abnormalities of the hip joint and surrounding structures. When a snapping hip is being investigated or corticosteroid injection is warranted, US can be of help in providing a dynamic study and by guiding the injection.	4
22. Song WS, Yoo JJ, Koo KH, Yoon KS, Kim YM, Kim HJ. Subchondral fatigue fracture of the femoral head in military recruits. <i>J Bone Joint Surg Am</i> 2004; 86-A(9):1917-1924.	14	5 patients 7 hips	To ascertain the characteristics of the rare condition of subchondral stress fracture of the femoral head by assessing the clinical course as well as radiographs, bone scintigrams, and MRI.	Definite abnormal findings were observed on the initial radiographs of 4 hips in 3 patients, and the femoral head was markedly collapsed in 2/4 hips. Bone scintigrams were made of 5 hips in 4 patients. In all affected hips, MRI demonstrated a localized or diffuse bone-marrow-edema pattern in the femoral head and/or neck. A subchondral fracture line (a magnetic resonance crescent sign) was identified in all hips.	4

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23. Tervonen O, Mueller DM, Matteson EL, Velosa JA, Ginsburg WW, Ehman RL. Clinically occult avascular necrosis of the hip: prevalence in an asymptomatic population at risk. <i>Radiology</i> 1992; 182(3):845-847.	13	100 patients 2 observers	Use MRI to determine the incidence of AVN in asymptomatic patients treated with corticosteroids.	6% of these patients demonstrated MR findings compatible with osteonecrosis.	2
24. Turner DA, Templeton AC, Selzer PM, Rosenberg AG, Petasnick JP. Femoral capital osteonecrosis: MR finding of diffuse marrow abnormalities without focal lesions. <i>Radiology</i> 1989; 171(1):135-140.	14	5 patients 6 hips	To demonstrate unusual MR appearance of osteonecrosis.	Diffuse abnormal signal within the femoral head and neck without a focal lesion may be the occasional MR appearance of osteonecrosis.	4
25. Vande Berg BC, Malghem J, Goffin EJ, Duprez TP, Maldague BE. Transient epiphyseal lesions in renal transplant recipients: presumed insufficiency stress fractures. <i>Radiology</i> 1994; 191(2):403-407.	9	16 patients 47 joints 2 observers reviewed radiographs 3 observers reviewed MR	To determine epiphyseal abnormalities in renal transplant recipients. Conventional radiographs and MRI were determined and correlated.	In 42/47 joints, T1-weighted MRI depicted 106 ill-delimited areas of low signal intensity. Stress fractures may have an MR appearance similar to osteonecrosis but are noted to disappear in one year's time.	2
26. Vande Berg BC, Malghem JJ, Lecouvet FE, Jamart J, Maldague BE. Idiopathic bone marrow edema lesions of the femoral head: predictive value of MR imaging findings. <i>Radiology</i> 1999; 212(2):527-535.	13	67 patients 72 lesions	Prospective study to compare irreversible and transient lesions for the frequency and extent of subchondral changes observed at MRI and to determine the features that most reliably enable differentiation between these lesions.	<ul style="list-style-type: none"> Lack of any additional subchondral change on T2-weighted or contrast-enhanced T1-weighted images had 100% PPV for transient lesions. For irreversible lesions, presence of a subchondral area of low signal intensity at least 4 mm thick or 12.5 mm long had PPVs of 85% and 73%, respectively, on T2-weighted images and 87% and 86%, respectively, on contrast-enhanced T1-weighted images. Careful assessment of subchondral changes allows the reliable differentiation between early irreversible lesions and transient BME lesions. 	2
27. Yamamoto T, Schneider R, Bullough PG. Subchondral insufficiency fracture of the femoral head: histopathologic correlation with MRI. <i>Skeletal Radiol</i> 2001; 30(5):247-254.	14	7	Retrospective review to correlate MR appearance of insufficiency fractures of the femoral head with histology.	Fractures demonstrate a subcortical, low signal band on T1-weighted images but diffuse bright signal on T2-weighted images (differs from osteonecrosis double-line sign).	4
28. Zoga AC, Morrison WB. Technical considerations in MR imaging of the hip. <i>Magn Reson Imaging Clin N Am</i> 2005; 13(4):617-634, v.	12	N/A	To discuss technical considerations in MRI of the hip.	MRI has become an integral tool in diagnosis of hip disease including osseous, articular and periarticular soft-tissue structures.	4

* See Last Page for Key

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29. Huang GS, Chan WP, Chang YC, Chang CY, Chen CY, Yu JS. MR imaging of bone marrow edema and joint effusion in patients with osteonecrosis of the femoral head: relationship to pain. <i>AJR</i> 2003; 181(2):545-549.	13	71 patients 110 hips	Prospective study to determine the occurrence of BME and joint effusion and their relationship to pain in patients with osteonecrosis of the femoral head on the basis of MRI. A comparison was made of 31 healthy hips in the affected patients to the 79 painful hips.	Both BME and joint effusions existed with a peak occurrence in stage III disease. BME seems to have a stronger association with pain than joint effusion in osteonecrosis of the femoral head.	2
30. Ito H, Matsuno T, Minami A. Relationship between bone marrow edema and development of symptoms in patients with osteonecrosis of the femoral head. <i>AJR</i> 2006; 186(6):1761-1770.	10	61 patients 83 hips	Prospective study to determine the significance of risk factors on MRI for predicting the outcome of patients with osteonecrosis of the femoral head, by following up asymptomatic or minimally symptomatic hips every 3 months to evaluate outcome.	BME strongly correlated with necrotic volume and was the most significant risk factor for worsening of hip pain. A large necrotic volume of 30% or more may be the second useful indicator for predicting future worsening of hip pain.	2
31. Theodorou DJ, Theodorou SJ, Haghighi P, Resnick D. Distinct focal lesions of the femoral head: imaging features suggesting an atypical and minimal form of bone necrosis. <i>Skeletal Radiol</i> 2002; 31(8):435-444.	13	11	To document the imaging findings observed in patients with an unusual pattern of abnormality of the femoral head, most likely representing osteonecrosis.	Radiography and CT showed areas of mixed bone sclerosis and osteolysis surrounded by sclerotic margins. On MRI, the signal intensity characteristics of the osseous lesion(s) were most commonly similar to those of fluid. Histopathologic findings, available in two hips, were typical of osteonecrosis. A distinct, focal lesion of the femoral head is believed to represent an atypical form of bone necrosis. Its restriction to a small portion of the femoral head may relate to localized vascular anatomy.	3
32. Zibis AH, Karantanas AH, Roidis NT, et al. The role of MR imaging in staging femoral head osteonecrosis. <i>Eur J Radiol</i> 2007; 63(1):3-9.	9	72 patients 115 hips	To correlate radiographs with MRI in femoral head osteonecrosis.	The ARCO classification could miss important information in stages II and III, where treatment aims at preservation of the hip joint integrity. The results of the present study suggest that MRI should be incorporated in the classification of osteonecrosis (stages II and III), to add accuracy and prognostic value.	2
33. Hou CH, Shih TT, Liu CY, Li YD, Enright T. Proton MR spectroscopy of the femoral head--evaluation of patients at risk for avascular necrosis. <i>J Magn Reson Imaging</i> 2006; 24(2):409-417.	13	94 patients (45 with osteonecrosis 49 matched controls)	A prospective, controlled comparative study of the femoral heads of patients with unilateral osteonecrosis of the hip and age-matched controls, to detect differences in the fatty component in the femoral head by measuring the in vivo lipid and water content.	Proton MRS can depict alteration in the lipid and water composition of normal-looking femoral heads with and without AVN on the contralateral hip. Proton MRS may be a potential tool for investigating of the femoral head component in vivo and predicting the risk for development of AVN.	3

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34. Khoury NJ, Birjawi GA, Chaaya M, Hourani MH. Use of limited MR protocol (coronal STIR) in the evaluation of patients with hip pain. <i>Skeletal Radiol</i> 2003; 32(10):567-574.	9	85 patients 93 examinations	A retrospective study of patients presenting with hip pain to assess the role of a limited MR protocol (coronal STIR) as the initial part of the MR examination in patients with hip pain. Two radiologists independently interpreted examinations separately.	For both readers, all normal MR examinations on the coronal STIR limited protocol were normal on the full protocol, with an interobserver reliability of 0.96. STIR protocol had 100% sensitivity and 65% specificity. A normal coronal STIR study of the hips in patients with hip pain and normal radiographs precludes the need for further pelvic MR sequences. Any abnormality detected on this limited protocol should be further assessed by additional MR sequences.	2
35. Lim KB, Eng AK, Chng SM, Tan AG, Thoo FL, Low CO. Limited magnetic resonance imaging (MRI) and the occult hip fracture. <i>Ann Acad Med Singapore</i> 2002; 31(5):607-610.	13	57	To report the results of limited MRI of hips in patients with negative or equivocal radiograph.	Limited MRI of the hip in this group of 57 patients confirmed that 14% sustained a femoral neck fracture, while 9% had an intertrochanteric fracture. In 33%, some other pathology was found, mainly stable fractures of the femoral trochanters and pubic rami. Limited MRI detected patients with undisplaced hip fractures and identified them as candidates for surgery. The use of MRI in this specific and 'limited' way provides orthopaedic surgeons with a rapid, accurate and cost-effective diagnostic tool in this clinical scenario.	3
36. Quinn SF, McCarthy JL. Prospective evaluation of patients with suspected hip fracture and indeterminate radiographs: use of T1-weighted MR images. <i>Radiology</i> 1993; 187(2):469-471.	10	20 patients 6 interpreters	To prospectively evaluate patients with suspected hip fracture and indeterminate radiographs to assess the diagnostic efficacy of T1-weighted MRI.	Accuracy of MR was 100% (20 correct diagnoses). T1-weighted MRI can enable diagnosis or exclusion of hip fracture whenever radiographs are indeterminate. The imaging time is approximately 7-minutes and the cost for the examination can be made competitive with charges for other advanced imaging studies.	2
37. Williams TR, Puckett ML, Denison G, Shin AY, Gorman JD. Acetabular stress fractures in military endurance athletes and recruits: incidence and MRI and scintigraphic findings. <i>Skeletal Radiol</i> 2002; 31(5):277-281.	15	187	To evaluate the incidence and the MRI and scintigraphic appearance of acetabular stress (fatigue) fractures in military endurance athletes and recruits. The study was originally designed to evaluate the MRI and scintigraphic appearance of femoral neck stress fractures.	12/178 patients (6.7%) had imaging findings consistent with acetabular stress fractures. Stress fractures are commonplace in military populations, especially endurance trainees. Acetabular stress fractures are rare and therefore unrecognized, but do occur and may be a cause for activity-related hip pain in a small percentage of military endurance athletes and recruits.	3

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38. De Smet AA, Best TM. MR imaging of the distribution and location of acute hamstring injuries in athletes. <i>AJR</i> 2000; 174(2):393-399.	13	15	To describe the MR appearance and location of acute hamstring muscle injuries.	Biceps femoris most commonly involved. One-third of patients injured more than one muscle. 40% of injuries were located distally.	3
39. Kingzett-Taylor A, Tirman PF, Feller J, et al. Tendinosis and tears of gluteus medius and minimus muscles as a cause of hip pain: MR imaging findings. <i>AJR</i> 1999; 173(4):1123-1126.	13	35	To describe the MR appearance of degeneration and tears of the gluteus muscles.	Degeneration and tears seen as high signal foci similar to tendon abnormalities elsewhere. Trochanteric bursitis frequently accompanies gluteal tendon tears/degeneration.	3
40. Shin AY, Morin WD, Gorman JD, Jones SB, Lapinsky AS. The superiority of magnetic resonance imaging in differentiating the cause of hip pain in endurance athletes. <i>Am J Sports Med</i> 1996; 24(2):168-176.	9	19	Prospective study to assess the accuracy of MRI in the detection of hip pain in athletes. Follow-up radiographs were used to verify the diagnosis of stress fracture.	MRI studies were as sensitive as and much more specific than bone scan. Radionuclide bone scan had an accuracy of 68% for femoral neck stress fractures with 32% false-positive results; MRI was 100% accurate.	3
41. Boutry N, Khalil C, Jaspard M, Marie-Helene V, Demondion X, Cotten A. Imaging of the hip in patients with rheumatic disorders. <i>Eur J Radiol</i> 2007; 63(1):49-58.	12	N/A	To discuss imaging of the hip in patients with rheumatic disorders.	Intravenous gadolinium-chelate agents are used to differentiate between joint fluid and synovitis.	4
42. Panicek DM, Gatsonis C, Rosenthal DI, et al. CT and MR imaging in the local staging of primary malignant musculoskeletal neoplasms: Report of the Radiology Diagnostic Oncology Group. <i>Radiology</i> 1997; 202(1):237-246.	9	316 patients CT-2 interpreters MR-2 interpreters	Multicenter study to determine the relative accuracy of CT and MR for the staging of primary malignant soft-tissue and osseous tumors. Compared imaging and histopathologic findings and supplemented when needed with surgical findings.	MR and CT are equally accurate for the local staging of primary malignant tumors of the MSK system.	1
43. Sundaram M, McGuire MH, Herbold DR. Magnetic resonance imaging of soft tissue masses: an evaluation of fifty-three histologically proven tumors. <i>Magn Reson Imaging</i> 1988; 6(3):237-248.	9	48 patients 53 tumors	Comparative study to evaluate histologically proven soft-tissue masses with MRI and CT.	MRI is superior for detection, but has limited value in characterizing soft-tissue sarcomas.	2
44. Zimmer WD, Berquist TH, McLeod RA, et al. Bone tumors: magnetic resonance imaging versus computed tomography. <i>Radiology</i> 1985; 155(3):709-718.	9	52 patients 3 reviewers	To examine the value of MRI in the evaluation of bone tumors, attempt to identify criteria useful in distinguishing various types of tumors, and compare MR with CT. 45 patients had CT scans available for comparison.	<ul style="list-style-type: none"> • For extent of tumor in marrow, MR was superior to CT in 33% of cases, about equal to CT in 64%, and inferior to CT in 2%. • For delineating the extent of tumor in soft-tissue, MR was superior to CT in 38% of cases and about equal to CT in 62%. • CT was superior in all cases for demonstrating calcific deposits and pathologic fractures. 	2

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45. Kursunoglu-Brahme S, Riccio T, Weisman MH, et al. Rheumatoid knee: role of gadopentetate-enhanced MR imaging. <i>Radiology</i> 1990; 176(3):831-835.	10	14	Prospective study to determine the ability of gadopentetate-enhanced MRI to distinguish between joint effusion and inflamed synovium in the knee joints of patients with rheumatoid arthritis.	Gadopentetate allows differentiation between synovial thickening and joint effusion in the knee, which may impact treatment decisions.	3
46. Assoun J, Richardi G, Railhac JJ, et al. Osteoid osteoma: MR imaging versus CT. <i>Radiology</i> 1994; 191(1):217-223.	9	19 patients 2 reviewers	Prospective study to compare CT with MRI in diagnosis of osteoid osteoma.	CT was superior to MRI in detection of the osteoid osteoma nidus in 63% of cases.	2
47. Liu PT, Chivers FS, Roberts CC, Schultz CJ, Beauchamp CP. Imaging of osteoid osteoma with dynamic gadolinium-enhanced MR imaging. <i>Radiology</i> 2003; 227(3):691-700.	9	11	Retrospective study to compare dynamic gadolinium-enhanced T1-weighted MRI with nonenhanced T1-weighted and T2-weighted MRI and thin-section CT for the demonstration of osteoid osteomas.	Compared to CT, dynamic gadolinium-enhanced MRI demonstrated osteoid osteoma equally well in 8/11 patients and with better conspicuity in 3/11 patients. Osteoid osteomas can be imaged with greater conspicuity by using dynamic gadolinium-enhanced instead of nonenhanced MRI and with conspicuity equal to or better than that obtained with thin-section CT.	3
48. Czerny C, Hofmann S, Urban M, et al. MR arthrography of the adult acetabular capsular-labral complex: correlation with surgery and anatomy. <i>AJR</i> 1999; 173(2):345-349.	10	40 patients 6 cadavers 2 observers	Prospectively review of MRI to determine the accuracy of MRA for the assessment of labral tears.	MRA has a sensitivity of 91%, a specificity of 71% and an accuracy of 88% for the detection of labral tears.	2
49. Neumann G, Mendicuti AD, Zou KH, et al. Prevalence of labral tears and cartilage loss in patients with mechanical symptoms of the hip: evaluation using MR arthrography. <i>Osteoarthritis Cartilage</i> 2007; 15(8):909-917.	10	100	To determine the prevalence of labral tears and cartilage lesions in patients with mechanical symptoms of the hip using MRA.	On MRA, labral tears were found in 66 patients (66% prevalence) with 13 having more than one location involved. Labral tears and cartilage loss are common in patients with mechanical symptoms in the hip. Cartilage loss, labral tears and BME appear interrelated and may represent important risk factors that may affect the development and progression of osteoarthritis in the hip joint.	2
50. Petersilge CA. MR arthrography for evaluation of the acetabular labrum. <i>Skeletal Radiol</i> 2001; 30(8):423-430.	12	N/A	To review the normal anatomy of the hip, the clinical presentation of internal derangement and the technique for performing MRA. The variations in morphology and signal of the asymptomatic labrum are reviewed as well as the appearance of the abnormal labrum.	With the joint distention provided by MRA, labral detachments and intrasubstance tears can be identified and differentiated from the many varied appearances of the asymptomatic labrum.	4
51. Petersilge CA, Haque MA, Petersilge WJ, Lewin JS, Lieberman JM, Buly R. Acetabular labral tears: evaluation with MR arthrography. <i>Radiology</i> 1996; 200(1):231-235.	10	10	To determine the usefulness of MRA in the diagnosis of acetabular labral tears.	Labral tears were diagnosed in 8 hips. MRA appears to be a promising imaging modality for accurate diagnosis of acetabular labral tears.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
52. Yoon LS, Palmer WE, Kassajian A. Evaluation of radial-sequence imaging in detecting acetabular labral tears at hip MR arthrography. <i>Skeletal Radiol</i> 2007; 36(11):1029-1033.	9	54	Retrospective study to determine whether radial imaging demonstrates labral tears not visible on standard imaging planes.	Using standard imaging planes, 50 anterosuperior, 31 posterosuperior, 10 anteroinferior, and 9 posteroinferior labral tears were detected in 54 MR arthrograms of the hip. Using radial sequences alone, 44 anterosuperior, 25 posterosuperior, 9 anteroinferior, and 5 posteroinferior labral tears were detected. In MRA of the hip, radial imaging did not reveal any additional labral tears. Standard imaging planes sufficiently demonstrate all acetabular labral tears.	2
53. Kassajian A, Yoon LS, Belzile E, Connolly SA, Millis MB, Palmer WE. Triad of MR arthrographic findings in patients with cam-type femoroacetabular impingement. <i>Radiology</i> 2005; 236(2):588-592.	13	40	To retrospectively analyze MR arthrographic findings in patients with clinical cam-type FAI.	MRA demonstrated a triad of abnormal head-neck morphology, anterosuperior cartilage abnormality, and anterosuperior labral abnormality in 37/42 patients with cam-type FAI.	3
54. Pfirrmann CW, Mengiardi B, Dora C, Kalberer F, Zanetti M, Hodler J. Cam and pincer femoroacetabular impingement: characteristic MR arthrographic findings in 50 patients. <i>Radiology</i> 2006; 240(3):778-785.	13	50	To retrospectively characterize MR arthrographic findings in patients with cam FAI and in those with pincer FAI.	Characteristic MR arthrographic findings of cam FAI include large alpha angles and cartilage lesions at the anterosuperior position and osseous bump formation at the femoral neck; characteristic findings of pincer FAI include a deep acetabulum and posteroinferior cartilage lesions.	2
55. Mosher TJ. Musculoskeletal imaging at 3T: current techniques and future applications. <i>Magn Reson Imaging Clin N Am</i> 2006; 14(1):63-76.	12	N/A	To review the current techniques and future applications at 3T MRI.	Initial experience with 3T MRI in the evaluation of the hip joint has been positive.	4
56. Ramnath RR. 3T MR imaging of the musculoskeletal system (Part II): clinical applications. <i>Magn Reson Imaging Clin N Am</i> 2006; 14(1):41-62.	12	N/A	To point the utility/advantages of 3T MRI and its clinical applications in the MSK system.	Because of the enhanced signal-to-noise ratio, the higher spatial resolution, and the greater contrast-to-noise of intrinsic joint structures at higher field strengths, 3T MRI has the potential to improve diagnostic abilities in the MSK system vastly, which translates into better patient care and management.	4

**Chronic Hip Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
57. Sundberg TP, Toomayan GA, Major NM. Evaluation of the acetabular labrum at 3.0-T MR imaging compared with 1.5-T MR arthrography: preliminary experience. <i>Radiology</i> 2006; 238(2):706-711.	9	8	A prospective study to compare imaging of the acetabular labrum with 3.0-T MRI and 1.5-T MRA in patients with hip pain and suspicion of labral disease.	MRI depicted four surgically confirmed labral tears that were identified at MRA, as well as one that was not visualized at MRA. MRI helped identify all other pathologic conditions that were diagnosed at MRA and helped identify one additional surgically confirmed focal articular cartilage lesion. These results provide encouraging support for evaluation with 3.0-T MRI over 1.5-T MRA.	3
58. James SL, Ali K, Malara F, Young D, O'Donnell J, Connell DA. MRI findings of femoroacetabular impingement. <i>AJR</i> 2006; 187(6):1412-1419.	9	46 patients 2 observers	To evaluate 1.5 T MRI in the identification of labral and articular cartilage lesions in patients with a clinical suspicion of FAI.	MRI provides a useful assessment of patients in whom a FAI is clinically suspected. A high-resolution, nonarthrographic technique can provide preoperative information regarding the presence and anatomic site of labral and cartilage abnormalities.	2
59. Mintz DN, Hooper T, Connell D, Buly R, Padgett DE, Potter HG. Magnetic resonance imaging of the hip: detection of labral and chondral abnormalities using noncontrast imaging. <i>Arthroscopy</i> 2005; 21(4):385-393.	9	92 patients 2 observers	Retrospective review of 92 hip MRI studies for the presence of acetabular labral and hyaline cartilage abnormality with arthroscopic correlation.	Noncontrast MRI of the hip, using an optimized protocol, can noninvasively identify labral and chondral pathology. Good interobserver agreement.	2
60. Alvarez C, Chicheportiche V, Lequesne M, Vicaut E, Laredo JD. Contribution of helical computed tomography to the evaluation of early hip osteoarthritis: a study in 18 patients. <i>Joint Bone Spine</i> 2005; 72(6):578-584.	9	18 patients 2 observers	A retrospective study to demonstrate that helical CTA with multiplanar reformations can document cartilage lesions and their characteristics in patients with suspected hip osteoarthritis and normal or inconclusive hip radiographs.	In patients with hip pain and normal radiographs, helical CTA can provide a diagnosis of hip osteoarthritis by showing cartilage lesions, which are usually located in the anterosuperior part of the acetabulum. Interobserver reproducibility was excellent for the helical CTA diagnosis of cartilage lesions.	3
61. Nishii T, Tanaka H, Nakanishi K, Sugano N, Miki H, Yoshikawa H. Fat-suppressed 3D spoiled gradient-echo MRI and MDCT arthrography of articular cartilage in patients with hip dysplasia. <i>AJR</i> 2005; 185(2):379-385.	9	18 patients 20 hips 2 observers	A prospective study to assess the diagnostic ability of MDCT arthrography for acetabular and femoral cartilage lesions in patients with hip dysplasia. Articular cartilage disorder was assessed with both MRI and CT arthrography in patients with acetabular dysplasia who did not have osteoarthritis or only had early stage osteoarthritis.	CT arthrography provided significantly higher sensitivity in the detection of grade II or higher lesions than MRI for both observers. Interobserver agreement in the detection of grade II or higher cartilage lesions was moderate (kappa = 0.53) on MRI and substantial (kappa = 0.78) on CT. MDCT arthrography is a sensitive and reproducible method for assessing articular cartilage lesions with substance loss in patients with hip dysplasia.	3

**Chronic Hip Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
62. Nishii T, Tanaka H, Sugano N, Miki H, Takao M, Yoshikawa H. Disorders of acetabular labrum and articular cartilage in hip dysplasia: evaluation using isotropic high-resolution CT arthrography with sequential radial reformation. <i>Osteoarthritis Cartilage</i> 2007; 15(3):251-257.	9	29 patients 41 hips	To evaluate the diagnostic ability of isotropic CT arthrography with radial reformation technique for detection of acetabular labral and articular cartilage disorders, and evaluate those interactions in hip dysplasia.	Sensitivity, specificity and accuracy of CT arthrography were 97%, 87%, 92% for labral tear and 88%, 82%, 85% for acetabular cartilage disorder, respectively. Isotropic CT arthrography with radial reformation technique allowed simultaneous, accurate assessment of labral and cartilage disorders in the whole acetabular circumference.	3
63. Beaulé PE, Zaragoza E, Motamedi K, Copelan N, Dorey FJ. Three-dimensional computed tomography of the hip in the assessment of femoroacetabular impingement. <i>J Orthop Res</i> 2005; 23(6):1286-1292.	13	42 patients (12 controls) 56 hips (20 controls)	To assess the anterior and posterior concavity of the femoral head-neck junction in painful, nondysplastic hips. MR gadolinium arthrography was performed to assess for labral and cartilage lesions. Alpha and beta angles measuring the anterior and posterior femoral head-neck junction concavities were also determined in 20 asymptomatic hips using 3D CT.	The mean alpha angle for the symptomatic and the control group were: 66.4 vs 43.8 (P=0.001), and for the beta angle 40.2 vs 43.8 (P=0.011), respectively. All but one of the symptomatic hips had a labral tear with 61% of these hips having associated cartilage damage. 3D CT represents an accurate tool to quantify the femoral head-neck concavity providing a non-invasive assessment of hips at risk of FAI.	2
64. Jacobsen S, Romer L, Soballe K. Degeneration in dysplastic hips. A computer tomography study. <i>Skeletal Radiol</i> 2005; 34(12):778-784.	13	193 patients 386 hips	To determine the pattern of degenerative change in moderate to severely dysplastic hips in young patients through CT radiography.	Degeneration was most often found in the anterolateral part of the dysplastic hip joints. Most cysts were located above the transition zone between the bony and the fibrocartilaginous acetabulum, and we found a significantly-increased number of cases with avulsed bony fragments at the antero-lateral labral insertion in dysplastic hips compared to normal hips. It seems likely that the early degenerative process in dysplastic hips originates at the watershed zone between the acetabular labrum and the acetabular cartilage in response to subluxation and FAI.	2
65. Jacobsen S, Romer L, Soballe K. The other hip in unilateral hip dysplasia. <i>Clin Orthop Relat Res</i> 2006; 446:239-246.	13	197 patients 41 control	A retrospective review of the transverse pelvic CT scans of consecutive patients at a single center with hip pain thought to be secondary to developmental dysplasia and a comparison to the scans of a healthy control group.	The joint anatomy of patients with developmental dysplasia differed from that of control subjects in almost all aspects. The data suggest that patients referred with seemingly unilateral developmental dysplasia also are at risk of having contralateral dysplastic malformation.	2

**Chronic Hip Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
66. Bruce W, Van Der Wall H, Storey G, Loneragan R, Pitsis G, Kannagara S. Bone scintigraphy in acetabular labral tears. <i>Clin Nucl Med</i> 2004; 29(8):465-468.	13	57	A retrospective study of bone scintigraphy in patients with acetabular labral tears diagnosed by MRI/arthroscopy compared to bone scintigraphy in patients without labral tears being investigated for other causes of hip pain.	Patients with labral tears had hyperemia of the superior or superomedial aspect of the acetabulum and increased delayed uptake in either a focal superior pattern or in an “eyebrow” pattern of a superomedial tear. This pattern was not seen in any other sources of hip pathology. Absence of this pattern carries a high negative predictive value for the diagnosis.	2
67. Vahlensieck M, Peterfy CG, Wischer T, et al. Indirect MR arthrography: optimization and clinical applications. <i>Radiology</i> 1996; 200(1):249-254.	9	14 healthy volunteers MRI 17 patients with joint disorders on MRA	To evaluate and optimize a method for producing MRI similar to MR arthrograms of multiple synovial joints with intravenous gadopentetate dimeglumine injection.	Indirect MRA of an exercised joint provides homogeneous enhancement and improved delineation of soft-tissue structures.	3
68. Winalski CS, Aliabadi P, Wright RJ, Shortkroff S, Sledge CB, Weissman BN. Enhancement of joint fluid with intravenously administered gadopentetate dimeglumine: technique, rationale, and implications. <i>Radiology</i> 1993; 187(1):179-185.	13	10 patients (2 asymptomatic volunteers and 8 patients with suspected meniscal tears)	To determine the feasibility of enhancing the joint fluid with IV injection of gadopentetate dimeglumine.	All subjects demonstrated enhancement of joint fluid with this technique.	3
69. Zoga AC, Schweitzer ME. Indirect magnetic resonance arthrography: applications in sports imaging. <i>Top Magn Reson Imaging</i> 2003; 14(1):25-33.	12	N/A	To review indirect MRA as an imaging tool with several advantages and disadvantages over both direct MRA and unenhanced MSK MRI.	Advantages of indirect MRA include enhancement of both intra-articular and extra-articular pathology without the need for an invasive, fluoroscopically guided arthrogram, as well as high sensitivity for re-injury in postoperative patients. Some potential disadvantages of this technique are enhancement of normal vascular tissues and difficulty in making a diagnosis dependent upon joint space distension in the absence of an effusion.	4
70. Berquist TH. Diagnostic and therapeutic injections as an aid to musculoskeletal diagnosis. <i>Semin Intervent Radiol</i> 1993; 10(4):326-343.	12	N/A	Describes use of diagnostic and therapeutic injections in MSK diagnosis.	Injections allow pain localization and short term diagnosis.	4

**Chronic Hip Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
71. Byrd JW, Jones KS. Diagnostic accuracy of clinical assessment, magnetic resonance imaging, magnetic resonance arthrography, and intra-articular injection in hip arthroscopy patients. <i>Am J Sports Med</i> 2004; 32(7):1668-1674.	9	40	A retrospective review of prospectively collected data to evaluate the accuracy of clinical assessment, high-resolution MRI, MRI with gadolinium arthrography and intra-articular bupivacaine injection, using arthroscopy as the definitive diagnosis.	Clinical assessment accurately determined the existence of intra-articular abnormality but was poor at defining its nature. MRA was much more sensitive than MRI at detecting various lesions but had twice as many false-positive interpretations. Response to an intra-articular injection of anesthetic was a 90% reliable indicator of intra-articular abnormality.	2
72. Braunstein EM, Cardinal E, Buckwalter KA, Capello W. Bupivacaine arthrography of the post-arthroplasty hip. <i>Skeletal Radiol</i> 1995; 24(7):519-521.	13	12	To examine whether addition of bupivacaine to the contrast material in arthrography of total hip prostheses provides reliable information as to whether the source of pain is intracapsular or extracapsular.	Use of bupivacaine injection correctly identified intra-articular source in 10/12 proven cases. Addition of bupivacaine provides additional information useful in management decisions regarding the necessity of revision arthroplasty.	3
73. Tigges S, Stiles RG, Meli RJ, Roberson JR. Hip aspiration: a cost-effective and accurate method of evaluating the potentially infected hip prosthesis. <i>Radiology</i> 1993; 189(2):485-488.	9	147	Compare results from preoperative aspiration cultures with results of operative cultures to evaluate the accuracy of hip aspiration for the detection of an infected prosthesis.	Hip aspiration had sensitivity of 92.8% and specificity of 91.7%, NPV of 99.2%, PPV of 54.2%. Hips aspiration is an accurate and cost-effective technique for the detection of an infected prosthesis.	2
74. Adler RS, Buly R, Ambrose R, Sculco T. Diagnostic and therapeutic use of sonography-guided iliopsoas peritendinous injections. <i>AJR</i> 2005; 185(4):940-943.	13	39	To review authors experience performing sonography-guided iliopsoas bursal/peritendinous injections as a diagnostic and therapeutic tool in the workup and treatment of patients with hip pain.	Sonography-guided iliopsoas bursal/peritendinous injections are useful in determining the cause of hip pain. They can provide relief to most patients with iliopsoas tendinosis/bursitis after hip replacement. The results of injection alone are not as successful in cases of idiopathic iliopsoas tendinosis/bursitis, but the technique can help determine which patients may benefit from a surgical tendon release.	3
75. Cardinal E, Buckwalter KA, Capello WN, Duval N. US of the snapping iliopsoas tendon. <i>Radiology</i> 1996; 198(2):521-522.	14	3	Case report to determine the value of US in the diagnosis of snapping iliopsoas tendon.	US is a useful dynamic noninvasive technique for diagnosing snapping iliopsoas tendon.	4
76. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/contrast_manual.aspx	15	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	3

Evidence Table Key

Study Type Key

Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.

1. Randomized Controlled Trial — Treatment
2. Controlled Trial
3. Observation Study
 - a. Cohort
 - b. Cross-sectional
 - c. Case-control
4. Clinical Series
5. Case reviews
6. Anecdotes
7. Reviews

8. Randomized Controlled Trial — Diagnostic
9. Comparative Assessment
10. Clinical Assessment
11. Quantitative Review
12. Qualitative Review
13. Descriptive Study
14. Case Report
15. Other (Described in text)

Strength of Evidence Key

- Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.
- Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.