

**Nontraumatic Knee Pain
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Laurin CA, Dussault R, Levesque HP. The tangential x-ray investigation of the patellofemoral joint: x-ray technique, diagnostic criteria and their interpretation. <i>Clin Orthop Relat Res</i> 1979; (144):16-26.	13	N/A	Description of the x-ray technique for tangential visualization of the patellofemoral joint.	Theoretically, the pathogenesis of chondromalacia patellae and patellofemoral osteoarthritis (OA) may be explained as manifestations of cartilage damage secondary to lateral patellofemoral hyperpressure and medial patellofemoral hyperpressure.	3
2. Merchant AC, Mercer RL, Jacobsen RH, Cool CR. Roentgenographic analysis of patellofemoral congruence. <i>J Bone Joint Surg Am</i> 1974; 56(7):1391-1396.	10	100 patients 200 knees	Develop a technique to help obtain accurate view of the patellofemoral joint and a technique to measure the degree of congruence of the patellofemoral joint.	The proposed technique gave an average sulcus angle of 138 degrees (range, 126 to 150 degrees; standard deviation, 6 degrees). Study proposes a new measurement to evaluate the degree of congruence of the patellofemoral joint, called the congruence angle.	3
3. Newberg AH, Seligson D. The patellofemoral joint: 30 degrees, 60 degrees, and 90 degrees views. <i>Radiology</i> 1980; 137(1 Pt 1):57-61.	13	70	Axial radiographs at 30 degrees, 60 degrees (Ficat views) were obtained for patients evaluated for abnormality of the patellofemoral. The examination technique and interpretation of the Ficat views are discussed.	In selected patients, the examination can yield valuable information not obtainable by other methods about the patellofemoral articulation, allowing differentiation of numerous patellar abnormalities from a torn meniscus.	3
4. Hayes CW, Conway WF. Evaluation of articular cartilage: radiographic and cross-sectional imaging techniques. <i>Radiographics</i> 1992; 12(3):409-428.	12	N/A	To examine the value of different imaging modalities in the evaluation of cartilage disorders.	Plain radiography is the preferred initial study for cartilage evaluation. CT performed after intra-articular injection of contrast material (ie, CT arthrography) improved accuracy but is limited to axial plane. Chondral and osteochondral fractures may be well demonstrated by MRI.	4
5. Brandt KD, Fife RS, Braunstein EM, Katz B. Radiographic grading of the severity of knee osteoarthritis: relation of the Kellgren and Lawrence grade to a grade based on joint space narrowing, and correlation with arthroscopic evidence of articular cartilage degeneration. <i>Arthritis Rheum</i> 1991; 34(11):1381-1386.	13	92	To examine radiographs of patients with chronic knee pain and radiographic evidence of OA according to the Kellgren and Lawrence criteria and grade OA severity with a scoring system that placed emphasis on space narrowing system (JSN).	Of 17 patients with normal radiographic findings, 7 had advanced tibiofemoral and/or patellofemoral compartment changes of OA seen at arthroscopy, emphasizing the insensitivity of the radiograph for detecting early articular cartilage loss. The JSN-weighted scale provided no advantage over the Kellgren and Lawrence criteria for assessing the severity of articular cartilage changes of OA.	3
6. Messieh SS, Fowler PJ, Munro T. Anteroposterior radiographs of the osteoarthritic knee. <i>J Bone Joint Surg Br</i> 1990; 72(4):639-640.	9	64	Use radiographs of patients to compare conventional with the standing tunnel view.	In 10 knees in which the conventional view suggested normal cartilage the standing tunnel view revealed severe degeneration.	3

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7. Altman RD, Fries JF, Bloch DA, et al. Radiographic assessment of progression in osteoarthritis. <i>Arthritis Rheum</i> 1987; 30(11):1214-1225.	13	Hands 24 pairs Hips 40 pairs Knees 32 pairs 8 readers	Blinded examination of radiographs by 8 readers to determine method of measurement for detecting progression of OA of the hip.	<ul style="list-style-type: none"> OA of the hand: greatest sensitivity was achieved by reading a single postero-anterior bilateral hand radiograph for narrowing, spurs, and erosions, and scoring 10 joints, using a scale of 0-3. OA of the hip: a single anteroposterior radiograph assessed for joint space narrowing and cyst formation yielded the greatest sensitivity. OA of the knee: anteroposterior radiograph, with weight-bearing, assessed for narrowing, spurs, and sclerosis in both the medial and lateral compartments yielded the greatest sensitivity. 	2
8. Leach RE, Gregg T, Siber FJ. Weight-bearing radiography in osteoarthritis of the knee. <i>Radiology</i> 1970; 97(2):265-268.	9	130	To compare weight bearing and nonweight bearing films and determine which one reveals accurate information of the joint cartilage and presence of varus or valgus deformities.	Weight bearing roentgenograms may disclose narrowing, whereas the nonweight bearing appear to be normal. Recommend routine bilateral weight bearing be included in roentgenographic examination of the arthritic knee.	2
9. Marklund T, Myrnerets R. Radiographic determination of cartilage height in the knee joint. <i>Acta Orthop Scand</i> 1974; 45(5):752-755.	13	19 patients 30 knees	To correlate radiographic detection of joint space narrowing to cartilage loss.	In 10 of the knee joints, no skeletal alterations were seen. Minimal osteophytes were observed in 5 knee joints. Pronounced skeletal alterations were seen in 15 knee joints. For standing position, reduction in the cartilage is more visible if radiograph is conducted with the knee flexed.	3
10. Rosenberg TD, Paulos LE, Parker RD, Coward DB, Scott SM. The forty-five-degree posteroanterior flexion weight-bearing radiograph of the knee. <i>J Bone Joint Surg Am</i> 1988; 70(10):1479-1483.	9	55	Compare postero-anterior weight-bearing radiographs that were made with the knee in 45 degrees of flexion, with conventional radiographs for patients who had surgical treatment for a lesion causing pain in one knee.	Postero-anterior weight-bearing radiographs that were made with the knee in 45 degrees of flexion were more accurate (p<0.01), more specific (no false-positives) (p<0.01), and more sensitive (fewer false-negatives) than the conventional extension weight-bearing anteroposterior radiographs.	2
11. Hunter DJ, Zhang YQ, Tu X, et al. Change in joint space width: hyaline articular cartilage loss or alteration in meniscus? <i>Arthritis Rheum</i> 2006; 54(8):2488-2495.	13	264	To explore the relative contribution of hyaline cartilage morphologic features and the meniscus to the radiographic joint space.	For change in medial joint space, both change in meniscal position and change in articular cartilage score contributed substantially to narrowing of the joint space.	2

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12. Chung CB, Skaf A, Roger B, Campos J, Stump X, Resnick D. Patellar tendon-lateral femoral condyle friction syndrome: MR imaging in 42 patients. <i>Skeletal Radiol</i> 2001; 30(12):694-697.	13	42 patients 2 readers	Retrospective review to demonstrate MRI findings between posterior inferolateral patellar tendon and lateral femoral condyle in patients with chronic anterior lateral pain.	MRI allows identification of changes related to patellar tendon lateral femoral condyle function syndrome.	2
13. Vincken PW, ter Braak AP, van Erkel AR, et al. MR imaging: effectiveness and costs at triage of patients with nonacute knee symptoms. <i>Radiology</i> 2007; 242(1):85-93.	8	584	To prospectively evaluate the cost and effectiveness of MRI performed to exclude the need for arthroscopy in patients with nonacute knee symptoms who are highly suspected clinically of having intra-articular knee abnormality.	MRI can be used without additional costs or disadvantageous effect on function to obviate arthroscopy in patients with nonacute knee symptoms who are highly suspected of having intra-articular knee abnormality.	1
14. McAlindon TE, Watt I, McCrae F, Goddard P, Dieppe PA. Magnetic resonance imaging in osteoarthritis of the knee: correlation with radiographic and scintigraphic findings. <i>Ann Rheum Dis</i> 1991; 50(1):14-19.	9	12 knees	To assess knee OA comparing MRI with scintigraphy findings.	Some MRI and scintigraphic appearances correlated: a. 'hyperintense osteophytosis' and ipsilateral 'tramline' scintigraphic uptake, suggesting increased fat content in 'active' osteophytes; b. subchondral signal change and 'extended' pattern, possibly reflecting inflammation, synovial leak, or fibrovascular repair; c. Patellofemoral joint signal changes and patellar isotope uptake.	3
15. Reiser MF, Vahlensieck M, Schuller H. Imaging of the knee joint with emphasis on magnetic resonance imaging. <i>Eur Radiol</i> 1992; 2:87-94.	9	20	Comparison of radiographs, CT and MRI to determine extent of OA.	MRI more sensitive for extent, severity and unique for determining meniscal and ligamentous damage.	
16. Sabiston CP, Adams ME, Li DK. Magnetic resonance imaging of osteoarthritis: correlation with gross pathology using an experimental model. <i>J Orthop Res</i> 1987; 5(2):164-172.	9	N/A	Use MRI of knees to study early changes of OA, correlate the images with gross pathology and to compare MRI with radiographs.	Abnormalities were evident on MRI as early as 4-weeks after the onset of the disease, which is 8-weeks before they appear on radiographs. Thus, MRI can show changes in OA earlier than radiography, and the images correlate with the gross pathology.	3
17. Kolman BH, Daffner RH, Sciulli RL, Soehnlén MW. Correlation of joint fluid and internal derangement on knee MRI. <i>Skeletal Radiol</i> 2004; 33(2):91-95.	13	115	To test the hypothesis that in symptomatic patients, knees in which MRI examinations demonstrate no significant effusion will also be free of internal derangement.	36 /115 (31%) examinations showed joint fluid with anteroposterior measurement of 10 mm or less in the lateral aspect of the suprapatellar pouch. While knees in which MRI demonstrate no significant effusion are most often free of internal derangement, there remain a significant number which will exhibit internal derangement. An anteroposterior measurement of 10 mm or less in the lateral aspect of the suprapatellar pouch is a reasonable threshold value for distinguishing a physiologic from a pathologic amount of joint fluid.	2

* See Last Page for Key

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18. Yamamoto T, Bullough PG. Spontaneous osteonecrosis of the knee: the result of subchondral insufficiency fracture. <i>J Bone Joint Surg Am</i> 2000; 82(6):858-866.	15	14	Analyze etiology of medial femoral osteonecrosis.	Histopathologic analysis documented subchondral insufficiency fractures are leading event resulting in localized osteonecrosis of medial femoral condyle.	3
19. Le Gars L, Savy JM, Orcel P, et al. Osteonecrosis-like syndrome of the medial tibial plateau can be due to a stress fracture. MR findings in 13 patients. <i>Rev Rhum Engl Ed</i> 1999; 66(6):323-330.	13	13	MR study with sagittal and coronal sections to demonstrate mechanism involved in "osteonecrosis-like syndrome of the medial tibial plateau."	T1-weighted images without gadolinium showed diffuse low signal from the epiphysis (n=12) containing an area of lower signal seen either as a crescent-shaped subchondral image (n=3/12) or as a linear image (n=9/12). T2-weighted images demonstrated diffuse high signal from the medial tibial plateau with persistence of the line of low signal (n=8/12).	3
20. Beltran J, Caudill JL, Herman LA, et al. Rheumatoid arthritis: MR imaging manifestations. <i>Radiology</i> 1987; 165(1):153-157.	10	17 patients 19 joints	Study on surface-coil MRI used on rheumatoid arthritis patients.	MRI may become a sensitive and objective method for quantitative assessment of the joint changes of rheumatoid arthritis.	3
21. Reiser MF, Naegele M. Inflammatory joint disease: static and dynamic gadolinium-enhanced MR imaging. <i>J Magn Reson Imaging</i> 1993; 3(1):307-310.	12	N/A	Review of role of dynamic gadolinium-enhanced MRI in inflammatory joint disease.	For planning of surgical or arthroscopic procedures, MRI has proved to be a valuable diagnostic tool in the workup of inflammatory joint disease for accurate staging of the extent of soft-tissue, cartilage, and bone manifestations of the inflammatory process.	4
22. Shanley DJ, Auber AE, Watabe JT, Buckner AB. Pigmented villonodular synovitis of the knee demonstrated on bone scan. Correlation with US, CT, and MRI. <i>Clin Nucl Med</i> 1992; 17(11):901-902.	9	1	To evaluate bone scan findings in a case of pigmented villonodular synovitis and its correlation with US, CT, and MRI.	US confirmed presence of joint effusion. CT image demonstrated the nodular appearance to the hypertrophied synovium within the distended suprapatellar bursa. MRI of left knee demonstrated low signal masses of hypertrophied synovium within the distended joint capsule.	4
23. Terrier F, Hricak H, Revel D, et al. Magnetic resonance imaging and spectroscopy of the periarticular inflammatory soft-tissue changes in experimental arthritis of the rat. <i>Invest Radiol</i> 1985; 20(8):813-823.	9	Rats	MRI and spectroscopy of the periarticular inflammatory soft-tissue changes in experimental arthritis of the rat.	In comparison with both conventional radiography and physical examination, early soft-tissue changes were detected more frequently by MRI. Study suggests MRI is likely to be of value for the early diagnosis of arthritis.	4
24. Yulish BS, Montanez J, Goodfellow DB, Bryan PJ, Mulopulos GP, Modic MT. Chondromalacia patellae: assessment with MR imaging. <i>Radiology</i> 1987; 164(3):763-766.	10	23	Observe MRI to determine if it could accurately demonstrate the patellar cartilage.	MRI is an accurate means of examining the posterior patellar cartilage and should be considered as an alternative to diagnostic arthroscopy when a chondromalacia patella is suspected.	3

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25. Chan WP, Lang P, Stevens MP, et al. Osteoarthritis of the knee: comparison of radiography, CT, and MR imaging to assess extent and severity. <i>AJR</i> 1991; 157(4):799-806.	9	20	Compare radiography, CT, and MRI to assess extent and severity of OA.	MRI is more sensitive than radiography and CT for assessing the extent and severity of OA changes.	3
26. Boegard TL, Rudling O, Petersson IF, Jonsson K. Magnetic resonance imaging of the knee in chronic knee pain. A 2-year follow-up. <i>Osteoarthritis Cartilage</i> 2001; 9(5):473-480.	13	47	To evaluate change in cartilage defects, subchondral lesions and meniscal abnormalities using MRI in a 2-year period of patients with knee pain.	Five new cartilage defects and 8 subchondral lesions appeared during the 2-year interval while 7 defects and 7 subchondral lesions disappeared. 32/93 cartilage defects (34%) and 19/32 subchondral lesions (59%) displayed an increase or a decrease in size over time. MRI can detect changes in cartilage, subchondral lesions and meniscal abnormalities.	2
27. Ghelman B, Hodge JC. Imaging of the patellofemoral joint. <i>Orthop Clin North Am</i> 1992; 23(4):523-543.	12	N/A	Review of the role of different imaging modalities (radiographs, CT, CT/arthrogram, radionuclide scans, and MRI).	Abnormalities of the patellofemoral joint are one of the main problems in internal derangement of the knee.	4
28. Konig H, Sauter R, Deimling M, Vogt M. Cartilage disorders: comparison of spin-echo, CHES, and FLASH sequence MR images. <i>Radiology</i> 1987; 164(3):753-758.	9	28 patients 8 volunteers	Comparative study of standard spin-echo images with water images obtained with the chemical shift selective (CHES) sequence and fast low angle shot (FLASH) sequence.	CHES-water and FLASH images proved superior to spin-echo images in demonstrating hyaline cartilage disorders. No difference between spin-echo, CHES, and FLASH in the detection of fibrocartilage disorders. Short imaging times and satisfactory depiction of cartilage alterations make FLASH a promising method.	3
29. Reiser MF, Bongartz G, Erlemann R, et al. Magnetic resonance in cartilaginous lesions of the knee joint with three-dimensional gradient-echo imaging. <i>Skeletal Radiol</i> 1988; 17(7):465-471.	9	41 25	Diagnosis of chondromalacia using 3D gradient-echo sequences was investigated in 41 patients, with arthroscopic verification in 25 patients.	FLASH-images in the axial plane proved to be the most efficacious technique for the diagnosis of chondromalacia.	3
30. Spritzer CE, Vogler JB, Martinez S, et al. MR imaging of the knee: preliminary results with a 3DFT GRASS pulse sequence. <i>AJR</i> 1988; 150(3):597-603.	9	17 patients (18 extremities)	Comparative study. Examine knees with a 3D Fourier transform, gradient-refocused acquisition in a steady state pulse sequence.	Overall accuracy of MRI of the knee could be improved by including 3D Fourier transform gradient-refocused pulse sequences.	3
31. Engel A. Magnetic resonance knee arthrography. Enhanced contrast by gadolinium complex in the rabbit and in humans. <i>Acta Orthop Scand Suppl</i> 1990; 240:1-57.	13	73	Review of fundamentals and technique of the intra-articular application of an MRI contrast agent in connection with MRI arthrography.	The evaluation of cartilage together with the possibility to assess all other structures in the knee joint is a special feature of MRI arthrography. The high sensitivity and specificity of this method makes it superior to the examination without contrast agent and comparable to diagnostic arthroscopy.	3

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32. Hajek PC, Baker LL, Sartoris DJ, Neumann CH, Resnick D. MR arthrography: anatomic-pathologic investigation. <i>Radiology</i> 1987; 163(1):141-147.	10	45 cadaveric specimens	Arthrography was performed before imaging specimens to enhance efficacy of MRI in evaluating articular soft-tissue structures. Contrast agents used were Gd-DTPA, 0.9% saline, diatrizoate, and air.	Gd-DTPA was the most effective. Saline and diatrizoate exhibited equivalent signal behavior and necessitated T2-weighted sequences, while air was not useful. Depiction of normal anatomy was enhanced with MR arthrography. Intra-articular contrast material may enhance the diagnostic capabilities of MRI in the setting of joint disease.	3
33. 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	Review findings on joint fluid enhancement after intravenous administration of gadopentetate dimeglumine.	The arthrographic effect may provide a more convenient alternative to intra-articular injection of gadopentetate dimeglumine for MR arthrography.	4
34. Hunter DJ, March L, Sambrook PN. The association of cartilage volume with knee pain. <i>Osteoarthritis Cartilage</i> 2003; 11(10):725-729.	9	133	Cross-sectional study to determine association between knee pain and MRI cartilage volume.	Alterations specifically in patellar volume cartilage loss is associated with pain, function and global scores of the WOMAC.	2
35. Ahlback S, Bauer GC, Bohne WH. Spontaneous osteonecrosis of the knee. <i>Arthritis Rheum</i> 1968; 11(6):705-733.	13	39 patients 40 knees	Review radiolucent lesion of subchondral bone in the medial femoral condyle and report the clinical, radiological, and anatomic findings.	A radiographically visible subchondral lesion in the knee joint may be a feature in several conditions: osteochondritis dissecans, OA, fracture, infection, neuropathy, tumor, and osteonecrosis.	3
36. Hayes CW, Conway WF, Daniel WW. MR imaging of bone marrow edema pattern: transient osteoporosis, transient bone marrow edema syndrome, or osteonecrosis. <i>Radiographics</i> 1993; 13(5):1001-1011; discussion 1012.	12	N/A	Review MRI of bone marrow edema pattern.	Transient osteoporosis can be distinguished from other causes of bone marrow edema pattern, particularly osteonecrosis, on the basis of clinical findings and the development of radiographically evident focal osteopenia within 8 weeks after the onset of pain.	4
37. Lotke PA, Ecker ML. Osteonecrosis of the knee. <i>J Bone Joint Surg Am</i> 1988; 70(3):470-473.	12	N/A	Review of idiopathic spontaneous osteonecrosis of the knee.	Spontaneous osteonecrosis will eventually be shown to be an important etiological in the development of degenerative changes in the knee.	4
38. De Smet AA, Ilahi OA, Graf BK. Untreated osteochondritis dissecans of the femoral condyles: prediction of patient outcome using radiographic and MR findings. <i>Skeletal Radiol</i> 1997; 26(8):463-467.	13	14	Retrospective review to determine the usefulness of radiographic and MRI findings in predicting the outcome of conservatively treated patients with femoral osteochondritis dissecans.	A good clinical outcome is likely when the femoral growth plate is open, when the osteochondritis dissecans is small, and when the lesion is stable by MRI.	3

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39. O'Connor MA, Palaniappan M, Khan N, Bruce CE. Osteochondritis dissecans of the knee in children. A comparison of MRI and arthroscopic findings. <i>J Bone Joint Surg Br</i> 2002; 84(2):258-262.	9	33	To determine if MRI accurately predicted the subsequent diagnostic arthroscopic findings in adolescents with osteochondritis dissecans of the knee.	MRI can be used to stage osteochondritis dissecans lesions accurately.	3
40. Pill SG, Ganley TJ, Milam RA, Lou JE, Meyer JS, Flynn JM. Role of magnetic resonance imaging and clinical criteria in predicting successful nonoperative treatment of osteochondritis dissecans in children. <i>J Pediatr Orthop</i> 2003; 23(1):102-108.	9	24 patients 27 lesions	To compare the value of MRI, radiographs, and clinical findings in predicting the success of nonoperative treatment of juvenile osteochondritis dissecans lesions.	Although no single factor was uniformly predictive of successful nonoperative treatment: young age, open physical, and MRI criteria for instability were amenable to nonoperative treatment.	2
41. Vande Berg BC, Lecouvet FE, Maldague B, Malghem J. MR appearance of cartilage defects of the knee: preliminary results of a spiral CT arthrography-guided analysis. <i>Eur Radiol</i> 2004; 14(2):208-214.	9	31 knees 2 observers	To determine signal intensity patterns of cartilage defects at MRI (fat-sat FSE PD axial) that was seen on spiral CT arthrography.	20% of grade 2A or higher lesions seen on CT arthrography were not seen on MRI.	2
42. Vande Berg BC, Lecouvet FE, Poilvache P, Dubuc JE, Maldague B, Malghem J. Anterior cruciate ligament tears and associated meniscal lesions: assessment at dual-detector spiral CT arthrography. <i>Radiology</i> 2002; 223(2):403-409.	9	125	Retrospective review to assess the sensitivity and specificity for helical CT arthrography in the evaluation of anterior cruciate ligament tears and associated meniscal lesions.	Helical CT arthrography is an accurate (ie, good sensitivity and specificity >90%) method for detecting anterior cruciate ligament tears and associated meniscal lesions.	2

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.