

Diagnostic Imaging Pathways - Knee Pain (Post Traumatic)

Population Covered By The Guidance

This pathway provides guidance on the imaging of adult trauma patients with a suspected knee injury. The pathway incorporates the validated Ottawa Knee Rules.

Date reviewed: August 2013

Date of next review: 2017/2018

Published: August 2013

Quick User Guide

Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram

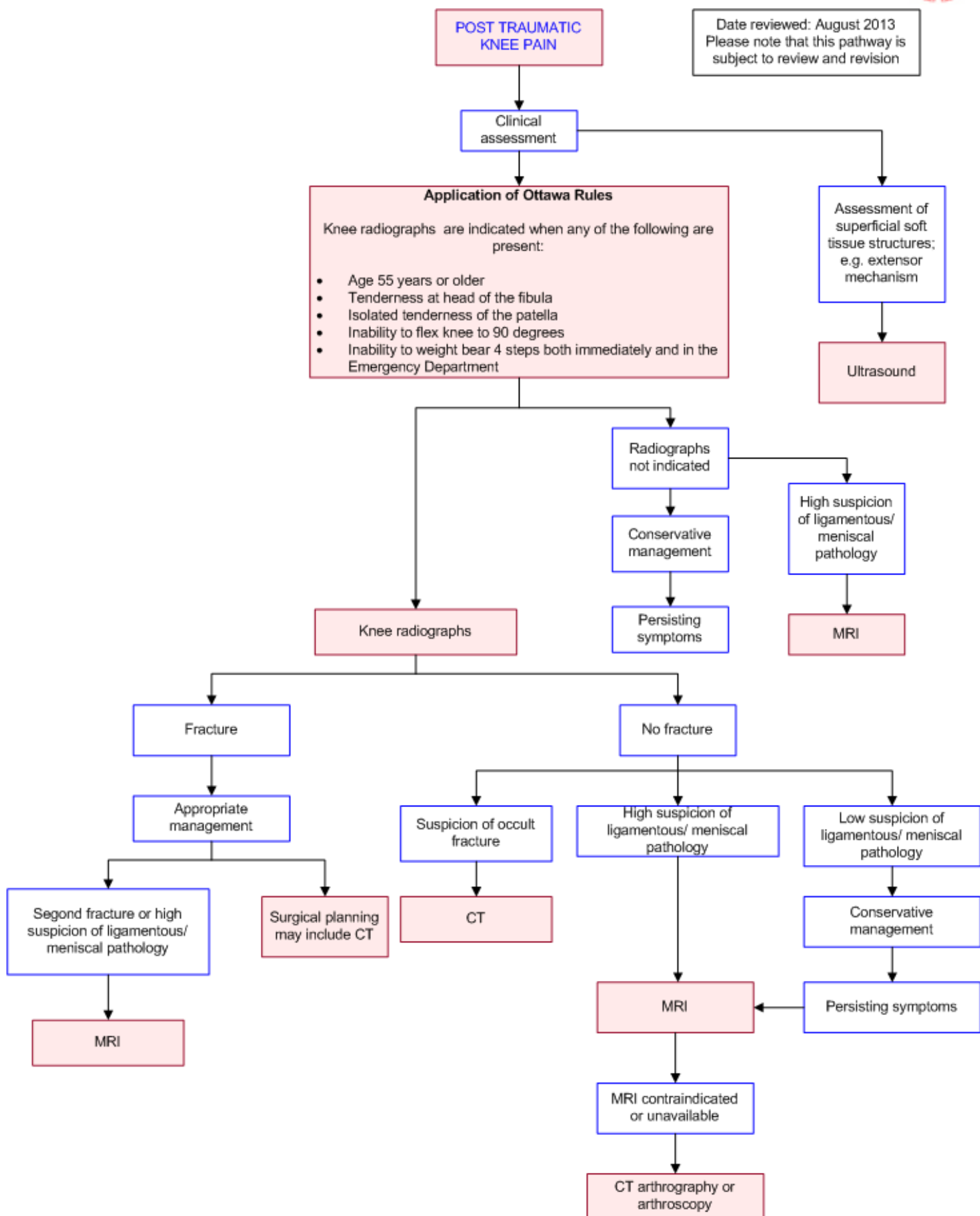
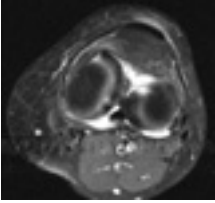


Image Gallery

Note: These images open in a new page

1a



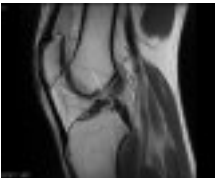
Medial Meniscal Injury

Image 1a and 1b (Magnetic Resonance Imaging): Axial and sagittal images demonstrating a bucket handle tear in the medial meniscus.

1b



2



Anterior Cruciate Ligament Rupture

Image 2 (Magnetic Resonance Imaging): Sagittal proton density image demonstrating an acute rupture of the mid substance of the anterior cruciate ligament (ACL) (arrows).

Teaching Points

- Most people who present with acute knee injuries have soft tissue rather than osseous injuries, and where fracture is present there is often accompanying soft tissue injury [1,2](#)
- Ottawa Rules in acute knee injury in adults: initial plain films of the knee are indicated when any of the following factors are present [3-7](#)
 - Age ? 55
 - Tenderness at the head of the fibula
 - Isolated tenderness of the patella
 - Inability to flex knee to 90 degrees
 - Inability to walk 4 weight bearing steps
- MRI is useful for the detection of ongoing knee instability following trauma to the knee, as it is able to accurately delineate the soft tissues of the joint
- CT has a lesser role in the assessment of post traumatic knee pain, though it is useful in demonstrating subtle bony injury and loose bodies within the knee joint and for pre-operative planning

Clinical Decision Rules for Radiography in Acute Knee Injury

- Two main validated clinical decision rules defining the guidelines for the appropriate use of radiographs in acute knee injuries are

Ottawa Knee Rules (OKR) [3-7](#)

- Radiography of the knee is indicated in adults if any of the following factors are present
 1. Age 55 years or older
 2. Tenderness at head of fibula
 3. Isolated tenderness of patella
 4. Inability to flex knee to 90 degrees
 5. Inability to walk four weight-bearing steps (defined as any weight transfer during walking) immediately after the injury and in the Emergency Department
- Exclusion criteria: Age 7 days prior to presentation, recent injuries being re-evaluated, and patients with altered levels of consciousness, paraplegia or multiple injuries
- A recent meta-analysis of six studies evaluating 4,249 patients showed a pooled sensitivity of 98.5% and pooled specificity 48.6% [7](#)
- Implementation of the OKR in a 1-year controlled trial of 4 Emergency Departments resulted in 26% reduced radiograph use (versus 1% in control group) without adverse consequences from overlooked fractures [6](#)

Pittsburgh Decision Rules (PDR) [8](#)

- The Pittsburgh rule advises radiographs if
 1. Age 50 years with a fall or injury involving a direct blow or mechanical force
 2. Age 12-50 years with a fall or trauma and inability to walk four full weight-bearing steps in the Emergency Department
- Exclusion criteria: Knee injuries sustained >6 days prior to presentation, patients with only superficial lacerations and abrasions, history of previous surgeries or fractures on the affected knee, and those being reassessed for the same injury
- The PDR has a reported 99% sensitivity and 60-79% specificity for the diagnosis of knee fractures [8,9](#)

- The Ottawa rules have been more extensively investigated in both cohort studies and randomised controlled trials of clinical implementation [6,7](#)
- The Pittsburgh knee rule appears more specific than the Ottawa rule without losing sensitivity and therefore may lead to less unnecessary radiography [10](#)
- Randomised control trials are necessary to definitively answer this question. Both can satisfactorily exclude fracture

Other predictive criteria

- Weber et al (1995) developed a non-validated clinical decision rule that excluded fractures in adults who could walk without limping or if there was a twisting injury to the knee and no joint effusion; omitting radiographs in these instances would reduce radiograph use by 29% without missing fractures [11](#)
- Bauer et al (1995) developed a non-validated clinical decision rule that excluded fractures in the absence of inability to weight-bear or presence of effusion or ecchymosis; omitting radiographs in these instances would reduce radiograph use by 39% without missing fractures [12](#)

Plain Radiography

- Initial imaging modality of choice for evaluation of post-traumatic knee pain or instability [13,14](#)
- Baseline views are anteroposterior (AP) and lateral; the addition of bilateral oblique views adds sensitivity but not specificity or overall diagnostic accuracy for fracture detection [15](#)
- If the lateral view is normal in the setting of acute trauma a fracture is unlikely [16](#)

Magnetic Resonance Imaging

- If history, examination and initial imaging studies are inconclusive or intra-articular and ligamentous injuries are suspected, MRI is preferred. [13,14](#) MRI significantly affects the clinical decision-making process and can often prevent unnecessary knee arthroscopy [17-22](#)
- High accuracy in detection of
 - Meniscal tears [20,21,23-25](#)
 - Cruciate ligament tears [20,21,23-25](#)
 - Collateral ligamentous injuries [26,27](#)
 - Osseous and chondral lesions, including occult fractures and dislocations, bone marrow oedema or 'bone bruise' and articular cartilage lesions. [28-33](#) MRI is relatively less accurate in detecting articular cartilage lesions due to lower sensitivity, but a high specificity (97-99% and high negative predictive value (97-98%) make it suitable for the exclusion of cartilage lesions [24,34](#)
- Advantages
 - Superior soft tissue contrast and ability to demonstrate both intra-articular and extra-articular abnormalities in a non-invasive test with no ionising radiation
- Limitations
 - Decreased diagnostic accuracy in patients with multiple injuries of the knee [26](#)
- A brief MRI in selected patients with acute knee injury without a fracture on radiography may reduce costs and potentially increase effectiveness [35](#)

Computed Tomography and Arthrography

- CT, with its superior spatial resolution, is useful in acute knee trauma in [2](#)
 - Severely injured patients where diagnostically sufficient radiographs are difficult to attain
 - Complex knee injuries to reveal fracture anatomy
 - Cases where fracture is suspected but radiographs are negative
 - The assessment of tibial plateau fractures, where it has comparable accuracy to MRI. [33](#)
Along with MRI can improve surgical planning [36](#)
- CT arthrography has a high diagnostic accuracy in detection of articular cartilage pathology and meniscal lesions but is limited by its invasiveness and use of ionising radiation. In practice, arthroscopy is a more useful tool for managing meniscoligamentous injuries than for diagnosing them. [36](#) It is useful where MRI is unavailable or contraindicated [37](#)

Ultrasonography

- While MRI is diagnostically superior, ultrasound is useful to quickly and inexpensively visualise superficial soft tissue structures and has the advantage of a dynamic evaluation of the knee in active and passive motion
- Useful in the rapid evaluation of tendon lesions, joint effusions, bursitis, and cysts [38](#)
- Accuracy assessing meniscus, ligamentous injury and cartilage damage varies widely between users

[39-41](#)

References

Date of literature search: March 2013

The search methodology is available on request. [Email](#)

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. [Download the document](#)

1. Shepherd L, Abdollahi K, Lee J, Vangsness CT. **The prevalence of soft tissue injuries in nonoperative tibial plateau fractures as determined by magnetic resonance imaging.** J Orthop Trauma. 2002;16(9):628-31. (Level III evidence)
2. Mustonen AOT, Koivikko MP, Lindahl J, Koskinen SK. **MRI of acute meniscal injury associated with tibial plateau fractures: prevalence, type, and location.** AJR Am J Roentgenol. 2008;191(4):1002-9. (Level III evidence)
3. Stiell IG, Greenberg GH, Wells GA, McKnight RD, Cwinn AA, Cacciotti T, et al. **Derivation of a decision rule for the use of radiography in acute knee injuries.** Ann Emerg Med. 1995;26(4):405-13. (Level II evidence)
4. Stiell IG, Greenberg GH, Wells GA, McDowell I, Cwinn AA, Smith NA, et al. **Prospective validation of a decision rule for the use of radiography in acute knee injuries.** JAMA. 1996;275(8):611-15. (Level I/II evidence)
5. Empananza JI, Aginaga JR. **Validation of the Ottawa Knee Rules.** Ann Emergency Med. 2001;38(4):364-8. (Level II evidence)
6. Stiell IG, Wells GA, Hoag RH, Sivilotti MLA, Cacciotti TF, Verbeek PR, et al. **Implementation of the Ottawa Knee Rule for the use of radiography in acute knee injuries.** JAMA. 1997;278(23):2075-9. (Level I/II evidence)
7. Bachmann LM, Haberketh S, Steurer J, ter Riet G. **The accuracy of the Ottawa knee rule to rule out knee fractures: a systematic review.** Ann Intern Med. 2004;140(2):121-4. (Level I evidence)
8. Seaberg DC, Jackson R. **Clinical decision rule for knee radiographs.** Am J Emerg Med. 1994;12(5):541-3. (Level II evidence)
9. Seaberg DC, Yealy DM, Lukens T, Auble T, Mathias S. **Multicenter comparison of two clinical decision rules for the use of radiography in acute, high-risk knee injuries.** Ann Emerg Med. 1998;32(1):8-13. (Level II evidence)
10. Cheung TC, Tank Y, Breederveld RS, Tuinebreijer WE, de Lange-de Klerk ESM, Derksen RJ. **Diagnostic accuracy and reproducibility of the Ottawa Knee Rule vs the Pittsburgh Decision Rule.** Am J Emerg Med. 2013;31(4):641-5. (Level II evidence)
11. Weber JE, Carley R, Jackson RE, Peacock WF, Swor RA, Larkin GL. **Clinical decision rules discriminate between fractures and nonfractures in acute isolated knee trauma.** Ann Emergency Med. 1995;26(4):429-33. (Level II/III evidence)
12. Bauer SJ, Hollander JE, Fuchs SH, Thode HC, Jr. **A clinical decision rule in the evaluation of acute knee injuries.** J Emerg Med. 1995;13(5):611-5. (Level II/III evidence)
13. Bussieres AE, Taylor JAM, Peterson C. **Diagnostic imaging practice guidelines for musculoskeletal complaints in adults - an evidence-based approach - Part 1: lower extremity disorders.** J Manipulative Physiol Ther. 2007;30(9):684-717. (Evidence based guidelines)
14. Tuite MJ, Daffner RH, Weissman BN, Bancroft L, Bennett DL, Blebea JS, et al. **ACR appropriateness criteria (R) acute trauma to the knee.** J Am Coll Radiol. 2012;9(2):96-103. (Evidence based guidelines)



15. Gray SD, Kaplan PA, Dussault RG, Omary RA, Campbell SE, Chrisman HB, et al. **Acute knee trauma: how many plain film views are necessary for the initial examination?** *Skeletal Radiol.* 1997;26(5):298-302. (Level II/III evidence)
16. Verma A, Su A, O'Marrah B, Golin AM, Amorosa JK. **A screening method for knee trauma.** *Acad Radiol.* 2001;8(5):392-7. (Level III evidence)
17. Nikken JJ, Oei EHG, Ginai AZ, Krestin GP, Verhaar JAN, van Vugt AB, et al. **Acute peripheral joint injury: cost and effectiveness of low-field-strength MR imaging — results of randomized controlled trial.** *Radiology.* 2005;236(3):958-67. (Level II evidence)
18. Vincken PWJ, ter Braak BPM, van Erkell A, de Rooy TPW, Mallens WMC, Post W, et al. **Effectiveness of MR imaging in selection of patients for arthroscopy of the knee.** *Radiology.* 2002;223(3):739-46. (Level II evidence)
19. BuiMansfield LT, Youngberg RA, Warme W, Pitcher JD, Nguyen PLL. **Potential cost savings of MR imaging obtained before arthroscopy of the knee: evaluation of 50 consecutive patients.** *AJR Am J Roentgenol.* 1997;168(4):913-8. (Level II evidence)
20. Crawford R, Walley G, Bridgman S, Maffulli N. **Magnetic resonance imaging versus arthroscopy in the diagnosis of knee pathology, concentrating on meniscal lesions and ACL tears: a systematic review.** *Br Med Bull.* 2007;84(1):5-23. (Level II evidence)
21. Oei EHG, Nikken JJ, Verstijnen ACM, Ginai AZ, Hunink MGM. **MR imaging of the menisci and cruciate ligaments: a systematic review.** *Radiology.* 2003;226(3):837-48. (Level I/II evidence)
22. Galea A, Giuffre B, Dimmick S, Coolican MRJ, Parker D. **The accuracy of magnetic resonance imaging scanning and its influence on management decisions in knee surgery.** *Arthroscopy.* 2009;25(5):473-80. (Level II evidence)
23. Fischer SP, Fox JM, Del Pizzo W, Friedman MJ, Snyder SJ, Ferkel RD. **Accuracy of diagnoses from magnetic resonance imaging of the knee. A multi-center analysis of one thousand and fourteen patients.** *J Bone Joint Surg Am.* 1991;73(1):2-10. (Level II/III evidence)
24. Vaz CES, de Camargo O, de Santana P, Valezi A. **Accuracy of magnetic resonance in identifying traumatic intraarticular knee lesions.** *Clinics (Sao Paulo).* 2005;60(6):445-50. (Level II evidence)
25. Munk B, Madsen F, Lundorf E, Staunstrup H, Schmidt SA, Bolvig L, et al. **Clinical magnetic resonance imaging and arthroscopic findings in knees: a comparative prospective study of meniscus anterior cruciate ligament and cartilage lesions.** *Arthroscopy.* 1998;14(2):171-5. (Level II/III evidence)
26. Rubin DA, Kettering JM, Towers JD, Britton CA. **MR imaging of knees having isolated and combined ligament injuries.** *AJR Am J Roentgenol.* 1998;170(5):1207-13. (Level II/III evidence)
27. Rasenberg EI, Lemmens JA, van Kampen A, Schoots F, Bloo HJ, Wagemakers HP, et al. **Grading medial collateral ligament injury: comparison of MR imaging and instrumented valgus-varus laxity test-device. A prospective double-blind patient study.** *Eur J Radiol.* 1995;21(1):18-24. (Level III evidence)
28. Kapelov SR, Teresi LM, Bradley WG, Bucciarelli NR, Murakami DM, Mullin WJ, et al. **Bone contusions of the knee - increased lesion detection with fast spin-echo MR-imaging with spectroscopic fat-saturation.** *Radiology.* 1993;189(3):901-4. (Level II/III evidence)
29. Mink JH, Deutsch AL. **Occult cartilage and bone injuries of the knee - detection, classification and assessment with MR imaging.** *Radiology.* 1989;170(3):823-9. (Level IV evidence)
30. Oei EHG, Ginai AZ, Hunink MGM. **MRI for traumatic knee injury: a review.** *Semin Ultrasound CT MR.* 2007;28(2):141-57. (Review article)
31. Smith T, Davies L, Toms A, Hing C, Donell S. **The reliability and validity of radiological assessment for patellar instability. A systematic review and meta-analysis.** *Skeletal Radiol.* 2011;40(4):399-414. (Level II evidence)
32. Potter HG, Linklater JM, Allen AA, Hannafin JA, Haas SB. **Magnetic resonance imaging of articular cartilage in the knee. An evaluation with use of fast-spin-echo imaging.** *J Bone Joint Surg.* 1998;80(9):1276-84. (Level III/IV evidence)



33. Kode L, Lieberman JM, Motta AO, Wilber JH, Vasen A, Yagan R. **Evaluation of tibial plateau fractures - efficacy of MR-imaging compared with CT.** AJR Am J Roentgenol. 1994;163(1):141-7. (Level IV evidence)
34. Friemert B, Oberlander Y, Schwarz W, Haberle HJ, Bahren W, Gerngross H, et al. **Diagnosis of chondral lesions of the knee joint: can MRI replace arthroscopy? A prospective study.** Knee Surg Sports Traumatol Arthrosc. 2004;12(1):58-64. (Level II evidence)
35. Oei EHG, Nikken J, Ginai A, Krestin G, Verhaar JAN, van Vugt A, et al. **Costs and effectiveness of a brief MRI examination of patients with acute knee injury.** Eur J Radiol. 2009;19(2):409-18. (Level II evidence)
36. Markhardt BK, Gross JM, Monu JUV. **Schatzker classification of tibial plateau fractures: use of CT and MR imaging improves assessment.** Radiographics. 2009;29(2):585-U333. (Review article)
37. 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.** Radiology. 2002;223(2):403-9. (Level II evidence)
38. Paczesny L, Kruczynski J. **Ultrasound of the knee.** Semin Ultrasound CT MR. 2011;32(2):114-24. (Review article)
39. Sandhu MS, Dhillon MS, Katariya S, Gopal V, Nagi ON. **High resolution sonography for analysis of meniscal injuries.** J Indian Med Assoc. 2007;105(1):49-50, 52. (Level III evidence)
40. Azzoni R, Cabitza P. **Is there a role for sonography in the diagnosis of tears of the knee menisci?** J Clin Ultrasound. 2002;30(8):472-6. (Level III evidence)
41. Khan Z, Faruqi Z, Ogyunbiyi O, Rosset G, Iqbal J. **Ultrasound assessment of internal derangement of the knee.** Acta Orthopaedica Belgica. 2006;72(1):72-6. (Level III evidence)

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