

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Cram P, Lu X, Kates SL, Singh JA, Li Y, Wolf BR. Total knee arthroplasty volume, utilization, and outcomes among Medicare beneficiaries, 1991-2010. <i>JAMA</i> . 2012;308(12):1227-1236.	Observational-Tx	3,271,851 patients	To examine longitudinal trends in volume, utilization, and outcomes for primary and revision TKA between 1991 and 2010 in the US Medicare population.	Between 1991 and 2010 annual primary TKA volume increased 161.5% from 93,230 to 243,802 while per capita utilization increased 99.2% (from 31.2 procedures per 10,000 Medicare enrollees in 1991 to 62.1 procedures per 10,000 in 2010). Revision TKA volume increased 105.9% from 9650 to 19,871 while per capita utilization increased 59.4% (from 3.2 procedures per 10,000 Medicare enrollees in 1991 to 5.1 procedures per 10,000 in 2010). For primary TKA, length of stay decreased from 7.9 days (95% CI, 7.8-7.9) in 1991-1994 to 3.5 days (95% CI, 3.5-3.5) in 2007-2010 ($P<.001$). For primary TKA, rates of adverse outcomes resulting in readmission remained stable between 1991-2010, but rates of all-cause 30-day readmission increased from 4.2% (95% CI, 4.1%-4.2%) to 5.0% (95% CI, 4.9%-5.0%) ($P<.001$). For revision TKA, the decrease in hospital length of stay was accompanied by an increase in all-cause 30-day readmission from 6.1% (95% CI, 5.9%-6.4%) to 8.9% (95% CI, 8.7%-9.2%) ($P<.001$) and an increase in readmission for wound infection from 1.4% (95% CI, 1.3%-1.5%) to 3.0% (95% CI, 2.9%-3.1%) ($P<.001$).	2
2. Daigle ME, Weinstein AM, Katz JN, Losina E. The cost-effectiveness of total joint arthroplasty: a systematic review of published literature. <i>Best Pract Res Clin Rheumatol</i> . 2012;26(5):649-658.	Review/Other-Tx	7 studies	To summarize the state of the literature evaluating the cost-effectiveness of elective THA and TKA.	7 studies presenting cost-effectiveness ratios for TKA and 6 studies for THA were included in our review. All economic evaluations of TKA were published between 2006 and 2012. By contrast, THA studies were published between 1996 and 2008. Out of the 13 studies evaluated in this review, 4 were from the societal perspective and 8 were from the payer perspective. 5 studies spanned the lifetime horizon. Of the selected studies, 6 used probabilistic sensitivity analysis to address uncertainty in data parameters. Both procedures have been shown to be highly cost-effective from the societal perspective over the entire lifespan.	4

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3. Agency for Healthcare Research and Quality (AHRQ). Healthcare Cost and Utilization Project (HCUP). http://www.ahrq.gov/research/data/hcup/index.html .	Review/Other-Tx	N/A	To enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, state, and local market levels.	N/A	4
4. Mulcahy H, Chew FS. Current concepts in knee replacement: features and imaging assessment. <i>AJR Am J Roentgenol</i> . 2013;201(6):W828-842.	Review/Other-Dx	N/A	To review current concepts of knee replacement.	It is well known that after knee replacement, patients with complications may be asymptomatic, and, for this reason, assessment of postoperative imaging is important. The foundation of radiologic interpretation of knee replacement is knowledge of the physiologic purpose, orthopedic trends, imaging findings, and complications.	4
5. Weinstein AM, Rome BN, Reichmann WM, et al. Estimating the burden of total knee replacement in the United States. <i>J Bone Joint Surg Am</i> . 2013;95(5):385-392.	Review/Other-Tx	N/A	To quantify the burden of TKR in the U.S. by estimating the number of adults currently alive with a primary or revision TKR.	We estimated that 4.0 million (95% CI: 3.6 million to 4.4 million) adults in the U.S. currently live with a TKR, representing 4.2% (95% CI: 3.7% to 4.6%) of the population 50 years of age or older. The prevalence was higher among females (4.8%) than among males (3.4%) and increased with age. The lifetime risk of primary TKR from the age of 25 years was 7.0% (95% CI: 6.1% to 7.8%) for males and 9.5% (95% CI: 8.5% to 10.5%) for females. Over half of adults in the U.S. diagnosed with knee osteoarthritis will undergo a TKR.	4
6. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. <i>J Bone Joint Surg Am</i> . 2007;89(4):780-785.	Review/Other-Tx	N/A	To formulate projections for the number of primary and revision THA and TKA that will be performed in the United States through 2030.	By 2030, the demand for primary THAs is estimated to grow by 174% to 572,000. The demand for primary TKAs is projected to grow by 673% to 3.48 million procedures. The demand for hip revision procedures is projected to double by the year 2026, while the demand for knee revisions is expected to double by 2015. Although hip revisions are currently more frequently performed than knee revisions, the demand for knee revisions is expected to surpass the demand for hip revisions after 2007. Overall, total hip and total knee revisions are projected to grow by 137% and 601%, respectively, between 2005 and 2030.	4

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7. Losina E, Thornhill TS, Rome BN, Wright J, Katz JN. The dramatic increase in total knee replacement utilization rates in the United States cannot be fully explained by growth in population size and the obesity epidemic. <i>J Bone Joint Surg Am.</i> 2012;94(3):201-207.	Review/Other-Tx	N/A	To investigate whether the rapid increase in TKR use over the past decade can be sufficiently attributed to changes in these 2 factors.	In 2008, 615,050 TKRs were performed in the United States adult population, 134% more than in 1999. During the same time period, the overall population size increased by 11%. While the population of 45 to 64-year-olds grew by 29%, the number of TKRs in this age group more than tripled. The number of obese and nonobese individuals in the United States increased by 23% and 4%, respectively. Assuming unchanged indications for TKR among obese and nonobese individuals with knee osteoarthritis over the last decade, these changes fail to account for the 134% growth in TKR use.	4
8. Seil R, Pape D. Causes of failure and etiology of painful primary total knee arthroplasty. <i>Knee Surg Sports Traumatol Arthrosc.</i> 2011;19(9):1418-1432.	Review/Other-Dx	N/A	To provide an overview of the causes of failure and the many different etiologies of a painful primary TKA.	Whereas biological etiologies like infections have remained stable over time, other causes of failure have changed. In the early times of knee arthroplasty, they were mainly related to technical insufficiencies. A better understanding of knee arthroplasty, patients' increasing functional demands as well as a continuous development of TKA techniques generated newer problems, which are increasingly related to the functioning of the soft-tissue envelope of the knee. From a therapeutic point of view, 3 situations can be considered: functional problems not needing reoperations, causes of reoperations not needing an exchange of prosthetic components as well as reoperations with exchange of at least 1 prosthetic component.	4

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9. Kurtz S, Mowat F, Ong K, Chan N, Lau E, Halpern M. Prevalence of primary and revision total hip and knee arthroplasty in the United States from 1990 through 2002. <i>J Bone Joint Surg Am.</i> 2005;87(7):1487-1497.	Review/Other-Tx	N/A	To quantify the procedural rate and revision burden of THA and TKA in the United States and to determine if the age or gender-based procedural rates and overall revision burden are changing over time.	Both the number and the rate of THA and TKA (particularly knee arthroplasties) increased steadily between 1990 and 2002. Over the 13 years, the rate of primary THAs per 100,000 persons increased by approximately 50%, whereas the corresponding rate of primary TKAs almost tripled. The rate of revision THAs increased by 3.7 procedures per 100,000 persons per decade, and that of revision TKAs, by 5.4 procedures per 100,000 persons per decade. However, the mean revision burden of 17.5% for THA was more than twice that for TKA (8.2%), and this did not change substantially over time.	4
10. Sharkey PF, Lichstein PM, Shen C, Tokarski AT, Parvizi J. Why are total knee arthroplasties failing today--has anything changed after 10 years? <i>J Arthroplasty.</i> 2014;29(9):1774-1778.	Review/Other-Tx	781 revision TKAs	To determine the frequency and cause of failure after TKA and compare the results with those reported by our similar investigation conducted 10 years ago.	A total of 781 revision TKAs performed at our institution over the past 10 years were identified. The most common failure mechanisms were: loosening (39.9%), infection (27.4%), instability (7.5%), periprosthetic fracture (4.7%), and arthrofibrosis (4.5%). Infection was the most common failure mechanism for early revision (<2 years from primary) and aseptic loosening was the most common reason for late revision. Polyethylene wear was no longer the major cause of failure. Compared to our previous report, the percentage of revisions performed for polyethylene wear, instability, arthrofibrosis, malalignment and extensor mechanism deficiency has decreased.	4

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11. Sharkey PF, Hozack WJ, Rothman RH, Shastri S, Jacoby SM. Insall Award paper. Why are total knee arthroplasties failing today? <i>Clin Orthop Relat Res.</i> 2002(404):7-13.	Review/Other-Tx	212 surgeries on 203 patients	To determine current mechanisms of failure of TKAs.	The reasons for failure listed in order of prevalence among the patients in this study include polyethylene wear, aseptic loosening, instability, infection, arthrofibrosis, malalignment or malposition, deficient extensor mechanism, avascular necrosis in the patella, periprosthetic fracture, and isolated patellar resurfacing. The cases reviewed included patients who had revision surgery within 9 days to 28 years (average, 3.7 years) after the previous surgery. More than half of the revisions in this group of patients were done <2 years after the index operation. 50% of early revision TKAs in this series was related to instability, malalignment or malposition, and failure of fixation.	4
12. Dennis DA. Evaluation of painful total knee arthroplasty. <i>J Arthroplasty.</i> 2004;19(4 Suppl 1):35-40.	Review/Other-Dx	N/A	To review the various causes of pain after TKA and suggestive methods of evaluation.	To critically evaluate the painful TKA, the treating physician must perform a thorough history and physical examination, as well as both laboratory and radiographic testing. Laboratory analysis is directed to differentiate septic vs aseptic etiologies of knee pain and commonly includes assessment of WBC count, ESR, CRP, and knee aspiration for cell count and cultures. Available radiographic tools include plain radiographs, stress views, arthrography, nuclear scanning, US, and MRI. In cases of unexplained pain, reoperation is unwise and frequently associated with suboptimal results. Periodic repeat evaluations are recommended until the etiology of pain is clearly determined.	4
13. Mandalia V, Eyres K, Schranz P, Toms AD. Evaluation of patients with a painful total knee replacement. <i>J Bone Joint Surg Br.</i> 2008;90(3):265-271.	Review/Other-Dx	N/A	To act as a guide to the evaluation of patients with painful TKR.	No results stated in abstract.	4

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14. Skytta ET, Lohman M, Tallroth K, Remes V. Comparison of standard anteroposterior knee and hip-to-ankle radiographs in determining the lower limb and implant alignment after total knee arthroplasty. <i>Scand J Surg.</i> 2009;98(4):250-253.	Observational-Dx	83 patients (103 knees)	To compare postoperative estimation of alignment and measurement of angles using both hip-to-ankle radiographs and anteroposterior knee radiographs in standing position.	The tibiofemoral angle measured from both hip-to-ankle and knee radiographs correlated moderately with the mechanical axis ($r = 0.646$ and $r = 0.540$, respectively). The correlation between tibiofemoral angles in the 2 radiographs was excellent ($r = 0.860$). Furthermore, measurements of tibial and femoral component alignment between the 2 radiographs correlated highly ($r = 0.718$ and $r = 0.773$, respectively). Intra- and interobserver correlations were high in all analyses.	3
15. Duff GP, Lachiewicz PF, Kelley SS. Aspiration of the knee joint before revision arthroplasty. <i>Clin Orthop Relat Res.</i> 1996(331):132-139.	Observational-Dx	64 operative procedures on 59 knees	To analyze the sensitivity, specificity, and accuracy of preoperative aspiration of the prosthetic knee joint before revision arthroplasty.	43 knees had a preoperative aspiration. In 19 knees, the aspiration showed growth on solid media, and in 18 of these knees the diagnosis of infection was confirmed by the intraoperative cultures. In 1 knee with an infected TKR, the patient was receiving an intravenous antibiotic at the time of arthroscopic irrigation and debridement and the cultures showed no growth. In 23 of 24 knees with a negative preoperative aspiration, the intraoperative cultures showed no growth on solid media. In 1 knee with a preoperative aspiration that had negative results, a single intraoperative culture grew <i>Staphylococcus epidermidis</i> . However, the presenting symptoms, examination, preoperative radiographs, and intraoperative evaluation were consistent with aseptic loosening of a cemented TKA. Thus, the preoperative aspiration of the prosthetic knee joint had a sensitivity of 100%, specificity of 100%, and accuracy of 100%. The Westergren ESR, peripheral leukocyte count, and presenting symptoms correlated poorly with infection. Radiographs were also not helpful in the diagnosis of infection, with loosening of components, periostitis, focal osteolysis, and radiolucent lines frequently seen in infected and noninfected knees.	3

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16. Malchau H, Potter HG. How are wear-related problems diagnosed and what forms of surveillance are necessary? <i>J Am Acad Orthop Surg.</i> 2008;16 Suppl 1:S14-19.	Review/Other-Dx	N/A	To review the diagnosis and surveillance of wear-related problems.	More complete assessment of wear-induced osteolysis in the general THA patient population must rely on registries with follow-up of large populations of patients through radiographic evaluation of wear-related factors, such as suboptimal placement of the implant components, osteolytic defects, and aseptic loosening. Follow-up radiographs should be obtained in the early postoperative period and at 1, 5, and 10 years postoperatively, and then every 1 to 5 years, thereafter depending on radiographic findings of osteolysis and its progression. When pathologic findings are present, further examinations, such as oblique Judet views and MRI with artifact minimization should be considered to provide a better determination of the extent of the osteolysis. Because conventional radiographs underestimate the prevalence and extent of osteolysis in many instances, diagnosis and surveillance should be performed with radiographic edge detection, spiral CT, MRI, radiostereometric analysis, and quantitation of wear and osteolysis, including bone and soft-tissue lesions. Helical CT has demonstrated excellent specificity in identifying and quantifying the extent of osteolysis. MRI can more accurately localize both osseous and soft-tissue particulate disease, and detect granuloma and compression on adjacent nerves and vessels.	4
17. Math KR, Zaidi SF, Petchprapa C, Harwin SF. Imaging of total knee arthroplasty. <i>Semin Musculoskelet Radiol.</i> 2006;10(1):47-63.	Review/Other-Dx	N/A	To review imaging findings of normal TKA, in addition to a variety of complications such as loosening, infection, instability, osteolysis, heterotopic ossification, extensor mechanism disruption, and fracture.	No results stated in abstract.	4

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18. Mulcahy H, Chew FS. Current concepts in knee replacement: complications. <i>AJR Am J Roentgenol.</i> 2014;202(1):W76-86.	Review/Other-Dx	N/A	To review current concepts of knee replacement, including features of traditional and newer prosthetic designs, materials, and surgical techniques; illustrate normal and abnormal postoperative imaging findings; and to relate the complications to current understanding of how and why these failures occur.	Complications after knee replacement may be asymptomatic. For this reason, assessment with postoperative imaging is important. The foundation of radiologic interpretation of knee replacement is knowledge of the physiologic purpose, orthopedic trends, imaging findings, and complications.	4
19. Nadaud MC, Fehring TK, Fehring K. Underestimation of osteolysis in posterior stabilized total knee arthroplasty. <i>J Arthroplasty.</i> 2004;19(1):110-115.	Review/Other-Dx	2 cases and 2 cadaver femurs	To show the extent to which condylar osteolysis can be underestimated on routine radiographs.	Lesions of 36 mm not easily discernible on standard anteroposterior and lateral images were easily recognized on oblique films.	4
20. Potter HG, Foo LF. Magnetic resonance imaging of joint arthroplasty. <i>Orthop Clin North Am.</i> 2006;37(3):361-373, vi-vii.	Review/Other-Dx	N/A	To review the application of MRI to joint arthroplasty.	No results stated in abstract.	4
21. Zotti MG, Campbell DG, Woodman R. Detection of periprosthetic osteolysis around total knee arthroplasties an in vitro study. <i>J Arthroplasty.</i> 2012;27(2):317-322.	Observational-Dx	3 cadaver knees	To examine the utility of lesion detection and volume appreciation with anteroposterior and lateral, paired oblique radiographs, and CT.	The results suggest that the current practice of anteroposterior and lateral is inferior for the assessment of periprosthetic osteolysis around TKA.	2
22. Glaser D, Lotke P. Cost-effectiveness of immediate postoperative radiographs after uncomplicated total knee arthroplasty: a retrospective and prospective study of 750 patients. <i>J Arthroplasty.</i> 2000;15(4):475-478.	Review/Other-Dx	750 patients	To question the value of postoperative radiographs after uncomplicated, primary TKA.	Of the 200 patients who underwent a primary TKA, 192 had postoperative radiographs performed before discharge. Among the 192 patients, the radiographs did not alter the postoperative management. In examining overall quality of the radiographs, only 36% were of sufficient quality to provide an accurate baseline for further studies. Total cost was approximately \$36,000. In the 550 patients who had the first postoperative radiograph performed at 6 weeks, there were no instances in which radiographs taken before discharge were needed to aid in further management or legal defense.	4
23. Niskanen RO. Early repetitive radiography is unnecessary after an uncomplicated cemented hip or knee arthroplasty for osteoarthritis. <i>Acta Orthop Belg.</i> 2005;71(6):692-695.	Review/Other-Dx	200 arthroplasties	To assess the value of routine repetitive radiographic examinations and the value of a reading of the images by a radiologist.	If postoperative radiographs are of good quality, there seems to be no need for early repetitive radiographs. Neither is a radiologist reading of the radiographs after joint arthroplasty of any benefit.	4

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24. Jazrawi LM, Birdzell L, Kummer FJ, Di Cesare PE. The accuracy of computed tomography for determining femoral and tibial total knee arthroplasty component rotation. <i>J Arthroplasty</i> . 2000;15(6):761-766.	Observational-Dx	6 cadavers	To ascertain the accuracy of CT scan for determining rotational alignment of femoral and tibial components in TKA.	The correlation coefficient between these 2 values averaged 0.87, which was significant at $P < .05$.	3
25. Bamberg F, Dierks A, Nikolaou K, Reiser MF, Becker CR, Johnson TR. Metal artifact reduction by dual energy computed tomography using monoenergetic extrapolation. <i>Eur Radiol</i> . 2011;21(7):1424-1429.	Observational-Dx	31 patients	To assess the performance and diagnostic value of a dual-energy CT approach to reduce metal artefacts in subjects with metallic implants.	Image quality was rated superior to the standard image in 29/31 high energy reconstructions; the diagnostic value was rated superior in 27 patients. Image quality and diagnostic value scores improved significantly from 3.5 to 2.1 and from 3.6 to 1.9, respectively. In several examinations decisive diagnostic features were only discernible in the high energy reconstructions. The density of the artefacts decreased from -882 to -341 HU.	3
26. Coupal TM, Mallinson PI, Gershony SL, et al. Getting the Most From Your Dual-Energy Scanner: Recognizing, Reducing, and Eliminating Artifacts. <i>AJR Am J Roentgenol</i> . 2016;206(1):119-128.	Review/Other-Dx	N/A	To describe these dual-energy CT protocols and compare each to its respective diagnostic reference standards, and to describe how to recognize, reduce, and eliminate dual-energy CT artifacts, thereby maximizing its diagnostic capabilities.	By implementing the protocols to reduce or eliminate artifacts reviewed here, radiologists will be able to maximize the clinical benefits from their dual-energy CT scanner throughout their daily practice.	4
27. Gupta A, Subhas N, Primak AN, Nittka M, Liu K. Metal artifact reduction: standard and advanced magnetic resonance and computed tomography techniques. <i>Radiol Clin North Am</i> . 2015;53(3):531-547.	Review/Other-Dx	N/A	To discuss the causes of metal artifacts on MRI and CT, contributing factors, and conventional and novel methods to reduce the effects of these artifacts on scans.	No results stated in abstract.	4
28. Kataoka ML, Hochman MG, Rodriguez EK, Lin PJ, Kubo S, Raptopoulos VD. A review of factors that affect artifact from metallic hardware on multi-row detector computed tomography. <i>Curr Probl Diagn Radiol</i> . 2010;39(4):125-136.	Review/Other-Dx	N/A	To highlight current strategies for reducing metallic hardware artifacts and presents some illustrative clinical cases.	Several conventional strategies are available for minimizing artifact from metallic hardware: use of higher kVp, higher mAs, patient positioning, and soft-tissue reconstruction algorithm. In addition, multidetector CT provides new opportunities for addressing artifacts from metallic hardware, including use of thinner section (0.5 mm) acquisitions; thicker reconstructions and multiplanar reformat technique; and choice of multiplanar reformat plane. Certain image reconstruction or filtering algorithms may also contribute to reduction of metallic artifacts.	4

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29. Pessis E, Campagna R, Sverzut JM, et al. Virtual monochromatic spectral imaging with fast kilovoltage switching: reduction of metal artifacts at CT. <i>Radiographics</i> . 2013;33(2):573-583.	Review/Other-Dx	N/A	To review the theory of virtual monochromatic spectral imaging and describe our clinical experience with a single-source dual-energy scanner with fast kilovoltage switching (ie, rapid alternation between high- and low-kilovoltage settings) to reduce beam-hardening artifact, using optimized protocols to improve diagnostic performance in patients with metal implants.	Despite advances in detector technology and computer software, artifacts from metal implants can seriously degrade the quality of CT images, sometimes to the point of making them diagnostically unusable. Several factors may help reduce the number and severity of artifacts at multidetector CT, including decreasing the detector collimation and pitch, increasing the kilovolt peak and tube charge, and using appropriate reconstruction algorithms and section thickness. More recently, dual-energy CT has been proposed as a means of reducing beam-hardening artifacts. The use of dual-energy CT scanners allows the synthesis of virtual monochromatic spectral images. Monochromatic images depict how the imaged object would look if the x-ray source produced x-ray photons at only a single energy level. For this reason, virtual monochromatic spectral imaging is expected to provide improved image quality by reducing beam-hardening artifacts.	4
30. Subhas N, Primak AN, Obuchowski NA, et al. Iterative metal artifact reduction: evaluation and optimization of technique. <i>Skeletal Radiol</i> . 2014;43(12):1729-1735.	Observational-Dx	8 patients with 9 total shoulder arthroplasties	To compare the image quality of iterative metal artifact reduction and weighted filtered back projection in total shoulder arthroplasties; determine the optimal amount of weighted filtered back projection high-frequency data needed for iterative metal artifact reduction; and compare image quality of the standard 3D technique with that of a faster 2D technique.	Attenuation differences were smaller with all 3D iterative metal artifact reduction techniques than with weighted filtered back projection ($P<0.0063$). With increasing high-frequency data, the attenuation difference increased slightly (differences not statistically significant). All readers ranked iterative metal artifact reduction moderate and iterative metal artifact reduction high more favorably than weighted filtered back projection ($P<0.05$), with iterative metal artifact reduction moderate ranked highest for most structures. The attenuation difference was slightly higher with 2D than with 3D iterative metal artifact reduction, with no significant reader preference for 3D over 2D.	2

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31. Zhou C, Zhao YE, Luo S, et al. Monoenergetic imaging of dual-energy CT reduces artifacts from implanted metal orthopedic devices in patients with fractures. <i>Acad Radiol.</i> 2011;18(10):1252-1257.	Observational-Dx	47 patients	To optimize photon energy setting to reduce metal artifact of CT images from implanted metal orthopedic devices in patients with fractures with monoenergetic imaging of dual-energy CT.	Monoenergetic imaging of dual-energy CT improved the quality of CT images in the fracture patients with metal orthopedic devices compared to the average weighted 120 kVp images for the total, external, and internal metal orthopedic devices (all <i>P</i> values <.01). Optimal keV setting with the lowest metal artifact was 130 keV for total, internal, and external metal orthopedic devices. Good inter-reader agreement was found for the evaluation of image quality for total, internal, and external metal orthopedic devices.	2
32. Fritz J, Lurie B, Potter HG. MR Imaging of Knee Arthroplasty Implants. <i>Radiographics.</i> 2015;35(5):1483-1501.	Review/Other-Dx	N/A	To discuss strategies for MRI of knee arthroplasty, discuss common knee arthroplasty-associated complications, and illustrate their MRI manifestations.	MRI with optimized conventional pulse sequences and advanced metal artifact reduction techniques can contribute important information for diagnosis, prognosis, risk stratification, and surgical planning.	4

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33. Hayter CL, Koff MF, Shah P, Koch KM, Miller TT, Potter HG. MRI after arthroplasty: comparison of MAVRIC and conventional fast spin-echo techniques. <i>AJR Am J Roentgenol.</i> 2011;197(3):W405-411.	Observational-Dx	122 patients	To evaluate the quality of images obtained with a prototype imaging technique, multiacquisition variable-resonance image combination, compared with fast spin-echo images in the evaluation of patients who have undergone hip, shoulder, or knee arthroplasty.	Visualization of the synovium was significantly better on multiacquisition variable-resonance image combination images than on fast spin-echo images of the hip ($P<0.0001$), shoulder ($P<0.01$), and knee ($P<0.01$). Synovitis was detected only on the multiacquisition variable-resonance image combination images of 9 subjects (12%) who had undergone hip arthroplasty and 5 subjects (18%) who had undergone shoulder arthroplasty. Visualization of the periprosthetic bone was significantly better on multiacquisition variable-resonance image combination images of the hip ($P<0.0001$), shoulder ($P<0.0001$), and knee ($P<0.01$). Osteolysis was detected only on the multiacquisition variable-resonance image combination images of 12 subjects (16%) who had undergone hip arthroplasty, 6 (22%) who had undergone shoulder arthroplasty, and 5 (24%) who had undergone knee arthroplasty. Visualization of the supraspinatus tendon was significantly better on multiacquisition variable-resonance image combination images ($P<0.0001$). Supraspinatus tendon tears in 12 subjects (44%) were detected only on multiacquisition variable-resonance image combination images.	3
34. Koch KM, Brau AC, Chen W, et al. Imaging near metal with a MAVRIC-SEMAC hybrid. <i>Magn Reson Med.</i> 2011;65(1):71-82.	Review/Other-Dx	6 cases	To describe the connection between the multiacquisition variable-resonance image combination and SEMAC and elaborate on the nuanced differences between them, to analyze the spectral properties in detail, to present a hybrid sequence, to demonstrate this hybrid method in a clinical setting and compare it to existing standard-of-care clinical images.	The presented technique is shown capable of producing minimal artifact, high-resolution images near total joint replacements in a clinical setting.	4

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35. Koch KM, Lorbiecki JE, Hinks RS, King KF. A multispectral three-dimensional acquisition technique for imaging near metal implants. <i>Magn Reson Med</i> . 2009;61(2):381-390.	Review/Other-Dx	N/A	To present a method whereby multiple 3D fast-spin-echo images are collected using discrete offsets in radio frequency transmission and reception frequency.	It is demonstrated that this multiacquisition variable-resonance image combination technique can be used to generate a composite image that is devoid of slice-plane distortion and possesses greatly reduced distortions in the readout direction, even in the immediate vicinity of metallic implants.	4
36. Lu W, Pauly KB, Gold GE, Pauly JM, Hargreaves BA. SEMAC: Slice Encoding for Metal Artifact Correction in MRI. <i>Magn Reson Med</i> . 2009;62(1):66-76.	Review/Other-Dx	2 cases	To address MRI near metallic implants with an innovative imaging technique called SEMAC.	The efficacy of the SEMAC technique in eliminating metal-induced distortions with feasible scan times is validated in phantom and in vivo spine and knee studies.	4
37. Plodkowski AJ, Hayter CL, Miller TT, Nguyen JT, Potter HG. Lamellated hyperintense synovitis: potential MR imaging sign of an infected knee arthroplasty. <i>Radiology</i> . 2013;266(1):256-260.	Observational-Dx	28 patients with proved infected TKA and 28 patients with noninfected arthroplasty	To determine the sensitivity and specificity of lamellated hyperintense synovitis for infection following knee arthroplasty and to determine the interobserver and intraobserver variability of this sign at MRI.	The sensitivity of lamellated hyperintense synovitis for infection was 0.86–0.92 (95% CI: 0.75, 0.97) and the specificity was 0.85–0.87 (95% CI: 0.74, 0.94). There was almost perfect interobserver agreement (kappa = 0.82; 95% CI: 0.72, 0.93; $P < 0.001$) and intraobserver agreement (for reader 1, kappa = 0.89 [95% CI: 0.78, 1.00; $P < 0.001$] and for reader 2, kappa = 0.89 [95% CI: 0.77, 1.00; $P < 0.001$]) in the classification of the synovial pattern.	2
38. Potter HG, Nestor BJ, Sofka CM, Ho ST, Peters LE, Salvati EA. Magnetic resonance imaging after total hip arthroplasty: evaluation of periprosthetic soft tissue. <i>J Bone Joint Surg Am</i> . 2004;86-A(9):1947-1954.	Review/Other-Dx	28 hips in 27 patients	To investigate the use of modified MRI techniques involving commercially available software to visualize periprosthetic soft tissues, to define the bone-implant interface, and to detect the location and extent of osteolysis.	MRI demonstrated the bone-implant interface and the surrounding soft-tissue envelope in all hips. Radiographs consistently underestimated the extent and location of acetabular osteolysis when compared with MRI. MRI also disclosed radiographically occult extraosseous soft-tissue deposits that were similar in signal intensity to areas of osteolysis, demonstrated the relationship of these deposits to adjacent neurovascular structures, and allowed further visualization of hypertrophic synovial deposits that accompanied the bone resorption in 25/28 hips.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
39. Sutter R, Hodek R, Fucentese SF, Nittka M, Pfirrmann CW. Total knee arthroplasty MRI featuring slice-encoding for metal artifact correction: reduction of artifacts for STIR and proton density-weighted sequences. <i>AJR Am J Roentgenol.</i> 2013;201(6):1315-1324.	Observational-Dx	42 TKA patients	To compare SEMAC sequences vs optimized standard MRI sequences in patients with TKA.	Signal void areas and insufficient fat saturation were smaller for the SEMAC sequences than for the optimized standard sequences ($P \leq 0.005$ for all comparisons). Depiction of anatomic structures was better on STIR with SEMAC vs standard sequences optimized with high bandwidth (score range, 2.9-3.7 vs 4.2-4.9) and on proton density-weighted imaging with SEMAC vs standard sequences optimized with high bandwidth (score range, 2.5-3.5 vs 3.1-3.8), which was statistically significant ($P < 0.001$ to $P = 0.007$ for different structures). Distortion and noise were lower for SEMAC than for the standard sequences ($P \leq 0.001$), whereas no technique had a clear advantage for blurring. Detection of abnormal imaging findings was markedly increased for the SEMAC technique ($P < 0.001$) and was most pronounced for STIR images (98 and 74 findings for STIR with SEMAC for readers 1 and 2, respectively, vs 37 and 37 findings for readers 1 and 2, respectively, for STIR with standard sequences optimized with high bandwidth). Sensitivity for detection of periprosthetic osteolysis was improved for STIR with SEMAC (100% and 86% for readers 1 and 2, respectively) compared with STIR with standard sequences optimized with high bandwidth (14% and 29% for readers 1 and 2, respectively).	2

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
40. Vessely MB, Frick MA, Oakes D, Wenger DE, Berry DJ. Magnetic resonance imaging with metal suppression for evaluation of periprosthetic osteolysis after total knee arthroplasty. <i>J Arthroplasty</i> . 2006;21(6):826-831.	Observational-Dx	11 patients	To report on MRI with metal suppression for the evaluation of suspected periprosthetic osteolysis around TKA.	The presence of osteolysis was identified or suspected radiographically in all of the 11 patients. Osteolysis was confirmed in 10 patients by MRI. In 9/11 patients, the extent of osteolysis was greater on MRI than estimated radiographically. In 5/11 patients, MRI demonstrated additional osteolytic lesions which were radiographically occult. In 1 case, the amount of osteolysis on MRI was less than on initial radiographs, and in 1 case, osteolysis was felt to be present radiographically but was not confirmed on MRI. In all 7/11 patients subsequently treated with revision TKA, MRI findings were confirmed at revision.	3
41. Li AE, Sneag DB, Greditzer HGt, Johnson CC, Miller TT, Potter HG. Total Knee Arthroplasty: Diagnostic Accuracy of Patterns of Synovitis at MR Imaging. <i>Radiology</i> . 2016;281(2):499-506.	Observational-Dx	108 patients	To determine the diagnostic accuracy of MRI for differentiating synovial patterns in patients with TKA, whether diagnostic accuracy differs in index vs revision TKA, and interobserver and intraobserver reliability for assessment of synovial patterns at MRI.	Results for all patients combined, MRI had 0.907-0.930 sensitivity and 0.723-0.738 specificity for a surgical diagnosis of complications related to polyethylene wear (including osteolysis and loosening); 0.652-0.783 sensitivity and 0.976-0.988 specificity for infection; and 0.643-0.667 sensitivity and 0.894-0.939 specificity for stiffness, instability, and nonspecific pain. Diagnostic accuracy was higher in the index TKA cohort than in the revision TKA cohort. Interobserver and intraobserver reliabilities were almost perfect (kappa = 0.82 and kappa = 0.83, respectively).	2
42. Heyse TJ, Chong le R, Davis J, Boettner F, Haas SB, Potter HG. MRI analysis of the component-bone interface after TKA. <i>Knee</i> . 2012;19(4):290-294.	Observational-Dx	55 patients	To describe and characterize the implant-bone interface of femoral, tibial and patellar components after TKA using MRI.	Excellent visibility, interobserver agreement and reliability was found for the interface of the tibial components, patellar buttons, and for femoral components made of zirconium. Conventional CoCrMo components caused significant artifact that interfered with the evaluation of the interface of femoral components.	4
43. Guillin R, Laporte JL, Sabouret P, Cardinal E. Polyethylene wear in knee arthroplasty: a new sonographic sign. <i>J Ultrasound Med</i> . 2008;27(2):275-279.	Review/Other-Dx	1 case report	To report a new sonographic sign of polyethylene wear in TKA with histologic correlation.	No results stated in abstract.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
44. Sofka CM, Adler RS, Laskin R. Sonography of polyethylene liners used in total knee arthroplasty. <i>AJR Am J Roentgenol.</i> 2003;180(5):1437-1441.	Observational-Dx	24 patients	To investigate the ability of US to reveal the polyethylene liner used in TKA with the hopes of establishing a possible relationship between the sonographic measurement of the actual thickness of the polyethylene liner and the estimated thickness based on conventional radiography.	The polyethylene liner is seen on US as a strong linear echogenic interface with posterior acoustic shadowing. Linear regression analyses showed a high correlation ($r = 0.8$) between the sonographic measurements and the radiographic measurements. A relatively poor correlation ($r = 0.2$) was noted between the manufacturers' stated size of the liner and the sonographic measurements.	4
45. Boutchichi A, Ciornohac J, Daubresse F. Pseudoaneurysm after total knee arthroplasty: a rare complication with different possible clinical presentations. <i>Acta Orthop Belg.</i> 2013;79(1):16-19.	Review/Other-Dx	3 patients	To report 3 cases of false aneurysm involving the popliteal artery or 1 of its branches following total knee replacement.	Doppler US and angio-CT investigations were used to achieve the correct diagnosis. 2 patients were treated by percutaneous embolization; the third patient required a mini-open surgery with an endovascular prosthesis. No complications were encountered.	4
46. Jansen JA, Smit F, Pereira Arias-Bouda LM. The role of nuclear medicine techniques in differentiation between septic and aseptic loosening of total hip and knee arthroplasty. <i>Tijdschr Nucl Geneesk.</i> 2012;34(4):988-994.	Observational-Dx	N/A	To give an overview of nuclear imaging techniques, which can be used to diagnose (a)septic loosening in joint replacements.	No results stated in abstract.	4
47. Love C, Marwin SE, Tomas MB, et al. Diagnosing infection in the failed joint replacement: a comparison of coincidence detection 18F-FDG and 111In-labeled leukocyte/99mTc-sulfur colloid marrow imaging. <i>J Nucl Med.</i> 2004;45(11):1864-1871.	Observational-Dx	59 patients	To investigate FDG imaging, using a coincidence detection system, for diagnosing PJI and to compare it with combined In-111-labeled leukocyte/Tc-99m-sulfur colloid marrow imaging in patients with failed lower extremity joint replacements.	25 (42%) prostheses, 14 hip and 11 knee, were infected. The sensitivity, specificity, and accuracy of FDG, by criterion, were as follows: criterion 1: 100%, 9%, 47%; criterion 2: 96%, 35%, 61%; criterion 3: 52%, 44%, 47%; criterion 4: 36%, 97%, 71%. The sensitivity, specificity, and accuracy of labeled leukocyte/marrow imaging were 100%, 91%, and 95%, respectively. WBC/marrow imaging, which was more accurate than any of the FDG criteria for all prostheses, as well as for hips and knees separately, was significantly more sensitive than criterion 3 ($P < 0.001$) and criterion 4 ($P < 0.001$) and was significantly more specific than criterion 1 ($P < 0.001$), criterion 2 ($P < 0.001$), and criterion 3 ($P < 0.001$).	3

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EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
48. Palestro CJ, Swyer AJ, Kim CK, Goldsmith SJ. Infected knee prosthesis: diagnosis with In-111 leukocyte, Tc-99m sulfur colloid, and Tc-99m MDP imaging. <i>Radiology</i> . 1991;179(3):645-648.	Observational-Dx	28 patients with 41 knee prostheses	To review the utility of In-111-labeled leukocyte scintigraphy and Tc-99m methylene diphosphonate bone scintigraphy, alone and in combination, as well as in In-111-labeled leukocyte scintigraphy combined with Tc-99m sulfur colloid marrow scintigraphy in the diagnosis of infected total knee prostheses.	9 prostheses were infected, and 32 were uninfected. The accuracy of combined labeled leukocyte and sulfur colloid marrow imaging (95%) was higher than that of labeled leukocyte scintigraphy alone (78%), bone scintigraphy alone (74%), or combined labeled leukocyte and bone scintigraphy (75%).	3
49. Pelosi E, Baiocco C, Pennone M, et al. 99mTc-HMPAO-leukocyte scintigraphy in patients with symptomatic total hip or knee arthroplasty: improved diagnostic accuracy by means of semiquantitative evaluation. <i>J Nucl Med</i> . 2004;45(3):438-444.	Observational-Dx	78 patients	To evaluate the diagnostic value, in suspected infectious prostheses, of Tc-99m-HMPAO leukocyte scintigraphy interpreted with the addition of a semiquantitative analysis.	On qualitative analysis, sensitivity, specificity, and accuracy were 80.4%–87%, 65.3%–71.4%, and 75.8%–77.9%, respectively. On semiquantitative analysis, sensitivity, specificity, and accuracy were 95.6%, 95.8%, and 95.8%, respectively. The analysis of 95% CIs showed statistically significant differences in specificity and accuracy between semiquantitative and qualitative analyses.	2
50. Joseph TN, Mujtaba M, Chen AL, et al. Efficacy of combined technetium-99m sulfur colloid/indium-111 leukocyte scans to detect infected total hip and knee arthroplasties. <i>J Arthroplasty</i> . 2001;16(6):753-758.	Observational-Dx	58 patients	To investigate the reliability of combined In-111 leukocyte/Tc-99m sulfur colloid scans, with and without the addition of blood pooling and blood flow studies, in the diagnosis of infected total joint arthroplasty.	Results for imaging alone included 100% specificity, 46% sensitivity, 100% PPV, 84% NPV, and 88% accuracy. Inclusion of blood pooling and flow phase data improved results to 66% sensitivity, 89% NPV, and 90% accuracy, with reductions in specificity (98%) and PPV (91%). Routine use of these radionuclide scans is not supported by these data.	3
51. Ververeli PA, Masonis JL, Booth RE, Hozack WJ, Rothman RH. Radiographic cost reduction strategy in total joint arthroplasty. A prospective analysis. <i>J Arthroplasty</i> . 1996;11(3):277-280.	Review/Other-Dx	222 patients	To determine if routine radiologic interpretation of postoperative total hip and total knee radiographs is cost effective. Also, the study was designed to determine if routine pre-discharge radiographs, in conjunction with recovery room radiographs, are worthwhile.	There were no changes in postoperative patient management based on orthopedic or radiologic review of either radiograph. No additional information was gained from review of the radiologic evaluations.	4
52. Hassan S, Wall A, Ayyaswamy B, Rogers S, Mills SP, Charalambous CP. Is there a need for early post-operative x-rays in primary total knee replacements? Experience of a centre in the UK. <i>Ann R Coll Surg Engl</i> . 2012;94(3):199-200.	Review/Other-Dx	624 TKRs	To assess the value of such early x-rays and whether they influenced the early postoperative management of these patients.	2 patients were found to have significant abnormalities: an undisplaced periprosthetic tibial fracture and a partial inferior pole patellar avulsion. Neither of these required further treatment or influenced mobility. No other complications were noted that changed routine post-operative management.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
53. Kosashvili Y, Alvi M, Mayne IP, Safir O, Gross A, Backstein D. Immediate recovery room radiographs after primary total knee arthroplasty-why do we keep doing them? <i>Int Orthop</i> . 2010;34(8):1167-1173.	Observational-Dx	24 surgeons (survey); 49 residents (9 radiographs from cadaver study)	To investigate the utility of recovery room radiographs routinely performed after TKA.	Surgeons rated the quality of the recovery room radiographs to be significantly lower than the radiographs taken in the radiology suite (5.5 +/- 2.5 vs 8.9 +/- 0.9, $P < 0.0001$). Of an estimated 65,910 TKAs performed by these surgeons, only 8 cases (0.01%) required same day revision based on the recovery room radiographs. Neutral alignment was significantly more accurately ($P < 0.0001$) interpreted than valgus or varus (69.4% vs 42.9% and 16.3%, respectively). Surprisingly, internal rotation of the limb significantly improved interpretation of both varus (from 16.3% to 40.8%, $P = 0.014$) and valgus (from 42.9% to 63.3%, $P = 0.048$). Increased level of orthopedic training did not significantly affect the accuracy of interpretation ($P = 0.46$).	2
54. Brown EC, 3rd, Clarke HD, Scuderi GR. The painful total knee arthroplasty: diagnosis and management. <i>Orthopedics</i> . 2006;29(2):129-136; quiz 137-128.	Review/Other-Dx	N/A	To present a practical approach to the evaluation and treatment of patients with problems after TKA.	A systematic evaluation of the patient and arthroplasty can lead to a definitive diagnosis of the cause of the patient's symptoms. Problems can be caused by a broad spectrum of possible etiologies. It is helpful to divide the differential diagnosis into 2 broad categories: extra-articular and intra-articular etiologies. When trying to establish the diagnosis, it is important to approach the task in a systematic fashion. Evaluation must begin with a thorough history and physical examination. Laboratory tests and imaging studies can provide additional evidence supporting a particular diagnosis. Once the etiology has been established, symptomatic relief may be achieved with appropriate treatment including revision TKA. However, revision TKA that is performed for unexplained pain is associated with a low probability of success.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
55. Clarke HD, Math KR, Scuderi GR. Polyethylene post failure in posterior stabilized total knee arthroplasty. <i>J Arthroplasty</i> . 2004;19(5):652-657.	Review/Other-Dx	1 patient	To present the evaluation and treatment of a 56-year-old woman who presented 63 months after TKA with a posterior-stabilized prosthesis with acute fracture of the polyethylene post, including the previously unreported use of CT arthrography to diagnose this rare problem.	No results stated in abstract.	4
56. Teeny SM, York SC, Mesko JW, Rea RE. Long-term follow-up care recommendations after total hip and knee arthroplasty: results of the American Association of Hip and Knee Surgeons' member survey. <i>J Arthroplasty</i> . 2003;18(8):954-962.	Review/Other-Dx	682 AAHKS members	To explicate current practice by identifying the range and diversity of long-term total hip and knee arthroplasty follow-up care recommendations made by members of the AAHKS to patients.	We found that 80% of respondents recommended annual or biennial orthopedic clinical and radiographic examinations, with more frequent follow-up times for clinical or radiologic signs of failure, previous revision arthroplasty, previous joint sepsis, and subnormal periprosthetic bone quality.	4
57. Collier MB, Jewett BA, Engh CA, Jr. Clinical assessment of tibial polyethylene thickness: comparison of radiographic measurements with as-implanted and as-retrieved thicknesses. <i>J Arthroplasty</i> . 2003;18(7):860-866.	Observational-Dx	66 TKAs	To determine and compare the accuracy of 2 methods using standard clinical anteroposterior radiographs made after implantation and before revision of the same arthroplasty.	66 posterior cruciate-retaining inserts of 1 fixed-bearing design were revised because of wear or osteolysis. Tibial polyethylene thickness was estimated from standard anteroposterior radiographs and compared with the original or final minimum thicknesses. The most accurate method involved measuring the shortest distance from each femoral condyle to a transverse line through the middle of the baseplate's superior surface. On radiographs acquired 6 weeks after arthroplasty, the mean error was -0.1 mm (underestimate) +/- 0.6 mm (standard deviation), with 72% of the measurements within 0.5 mm of the original minimum thickness and 87% within 1.0 mm. The method was less accurate for radiographs made before revision, for which the mean error was 0.6 mm (overestimate) +/- 1.0 mm. In this study, 41% and 70% of the prerevision measurements were accurate to within 0.5 and 1.0 mm, respectively.	3

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
58. Hide IG, Grainger AJ, Wallace IW, Hui A, Campbell RS. A radiological technique for the assessment of wear in prosthetic knee replacements. <i>Skeletal Radiol.</i> 2000;29(10):583-586.	Observational-Dx	9 images from phantom and 24 patients	To evaluate a simple, digital fluoroscopic technique for the assessment of wear in knee prostheses.	Standard phantom images showed small variation between measurements, high inter-reader correlation (Pearson's correlation coefficient, $r=0.98$, $P<0.001$; coefficient of variation=0.53%) and low intra-reader variation (coefficient of variation=0.57%). Inter- and intra-imager variation were low (coefficient of variation=1.05% and 0.88%, respectively). In the patient group, the range of joint space measurements was 1.9-8.9 mm. The coefficient of variation in insert measurements on repeated images was 2.0%. Repeatability of measurements was 0.2 mm with 99% CI.	3
59. Sanzen L, Sahlstrom A, Gentz CF, Johnell IR. Radiographic wear assessment in a total knee prosthesis. 5- to 9-year follow-up study of 158 knees. <i>J Arthroplasty.</i> 1996;11(6):738-742.	Observational-Tx	158 knee prostheses	To evaluate the use of an image intensifier to obtain correctly projected stress radiographs and digitized measurements of the penetration of the femoral component into the fibial plastic insert.	158 Porous-Coated Anatomic (Howmedica, Rutherford, NJ) primary total knee prostheses were evaluated clinically and radiographically to measure the remaining thickness of the plastic insert. Anteroposterior radiographs were taken with the beam guided parallel to the tibial plate by a fluoroscope. The knees were forced into varus and valgus, and the heights of the medial and lateral joint spaces, respectively, were measured with a digitizing table. Plastic insert wear could be calculated after correction with a magnification error factor, established by dividing the projected width of the tibial plate by the true size of the used component. After a mean follow-up period of 84 months (range, 58-116 months), wear was significantly higher for patients with osteoarthritis than rheumatoid arthritis and was 1.4 mm vs 0.7 mm medially ($P<.0001$) and 0.7 mm vs 0.4 mm laterally ($P=.01$). Wear was not correlated to thickness of the plastic insert or length of follow-up period. Young age or varus alignment contributed slightly to the amount of wear.	2

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
60. Yashar AA, Adler RS, Grady-Benson JC, Matthews LS, Freiberg AA. An ultrasound method to evaluate polyethylene component wear in total knee replacement arthroplasty. <i>Am J Orthop (Belle Mead NJ)</i> . 1996;25(10):702-704.	Observational-Dx	5 measurements at 3 locations on 1 cadaver	To assess an US method to evaluate polyethylene insert shape and thickness with the ability to clearly demonstrate structural loss of plastic.	Coefficient of variation (r2) ranged from 1.6% to 8.3% for the US measurements, and 0.26% to 1.5% for the caliper measurements. A plot of US vs caliper measurements allowed calculation of a linear equation, with r2 = 0.98, demonstrating high correlation between the 2 measurements. Our US measurements are accurate to 0.5 mm with a 95% CI. US is an accurate way to measure the dimensions of the polyethylene liner in TKR arthroplasty.	3
61. Bradshaw DA, Lam B, Hoffman R, Zicat B. Case report: Total knee arthroplasty polyethylene liner disengagement identified by arthrography. <i>Knee</i> . 2014;21(6):1288-1290.	Review/Other-Dx	1 case	To report a case of TKA polyethylene liner disengagement identified by plain film arthrography and CT arthrography.	No results stated in abstract.	4
62. Del Pozo JL, Patel R. Clinical practice. Infection associated with prosthetic joints. <i>N Engl J Med</i> . 2009;361(8):787-794.	Review/Other-Dx	N/A	To present a case vignette highlighting a common clinical problem.	No results stated in abstract.	4
63. Bach CM, Sturmer R, Nogler M, Wimmer C, Biedermann R, Krismer M. Total knee arthroplasty infection: significance of delayed aspiration. <i>J Arthroplasty</i> . 2002;17(5):615-618.	Observational-Tx	35 patients	To investigate the significance of delayed aspiration and the success of treatment.	In 13 patients, aspiration was performed within 3 months after the onset of symptoms of infection. The median duration of treatment was 243 days, and infection was arrested in all patients. In 22 patients, aspiration was performed >3 months after the onset of symptoms. The duration of treatment was significantly longer in these patients ($P<.001$). Persistent infection was recorded in 8 patients, and amputation of the involved leg was done in 3 patients. Aspiration within 3 months after the onset of symptoms of infection significantly reduced the duration of treatment and increased the chances of successfully arresting infection.	2

Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
64. Berbari EF, Marculescu C, Sia I, et al. Culture-negative prosthetic joint infection. <i>Clin Infect Dis.</i> 2007;45(9):1113-1119.	Observational-Tx	897 episodes	To define the demographic characteristics and determine the outcome of patients with culture-negative PJI.	Of 897 episodes of PJI during the study period, 60 (7%) occurred in patients for whom this was the initial episode of culture-negative PJI. The median age of the cohort was 69 years (range, 36-87 years). Patients had received a prior course of antimicrobial therapy in 32 (53%) of 60 episodes. Of the 60 episodes, 34 (57%), 12 (20%), and 8 (13%) were treated with 2-stage exchange, debridement and retention, and permanent resection arthroplasty, respectively. The median duration of parenteral antimicrobial therapy was 28 days (range, 0-88 days). 49 (82%) of 60 episodes were treated with a cephalosporin. The 5-year estimate of survival free of treatment failure was 94% (95% CI, 85%–100%) for patients treated with 2-stage exchange and 71% (95% CI, 44%–100%) for patients treated with debridement and retention.	2
65. Leone JM, Hanssen AD. Management of infection at the site of a total knee arthroplasty. <i>J Bone Joint Surg Am.</i> 2005;87(10):2335-2348.	Review/Other-Dx	N/A	No abstract available.	No abstract available.	4
66. American Academy of Orthopaedic Surgeons. The Diagnosis of Periprosthetic Joint Infections of the Hip and Knee. Guidelines and Evidence Report. 2010; http://www.aaos.org/research/guidelines/PJguideline.pdf .	Review/Other-Dx	N/A	To help improve treatment based on the current best evidence.	No results stated in abstract.	4
67. Magnuson JE, Brown ML, Hauser MF, Berquist TH, Fitzgerald RH, Jr., Klee GG. In-111-labeled leukocyte scintigraphy in suspected orthopedic prosthesis infection: comparison with other imaging modalities. <i>Radiology.</i> 1988;168(1):235-239.	Observational-Dx	98 patients	To report our experience with In-111 WBC scanning in the diagnosis of per-prosthetic infection, in comparison with other imaging tests, clinical signs, and laboratory measurements.	Positive findings on In-111 WBC scans and elevated ESRs were found to be the most predictive variables in the diagnosis of septic prostheses ($P \leq .001$ and $P \leq .002$, respectively). Likelihood ratio analysis more clearly demonstrated the superiority of In-111 WBC scanning, with positive and negative scans yielding likelihood ratios of 5.0 and 0.16, respectively.	3

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
68. Virolainen P, Lahteenmaki H, Hiltunen A, Sipola E, Meurman O, Nelimarkka O. The reliability of diagnosis of infection during revision arthroplasties. <i>Scand J Surg</i> . 2002;91(2):178-181.	Observational-Dx	68 hip and knee revision arthroplasties	To evaluate the reliability of clinical, radiological and laboratory examinations in identifying infection of total joint arthroplasties.	We were not able to characterize the infection by clinical signs. Also no single test was able to show the presence of infection in all cases. The best results were obtained from pre- and perioperative joint aspirations. Joint aspiration showed 1.0 specificity and 0.75 sensitivity.	3
69. Bernard L, Lubbeke A, Stern R, et al. Value of preoperative investigations in diagnosing prosthetic joint infection: retrospective cohort study and literature review. <i>Scand J Infect Dis</i> . 2004;36(6-7):410-416.	Observational-Dx	230 patients	To compare the following different diagnostic tools for diagnosing PJI: clinical assessments including fever, pain, and fistula; CRP; ESR; polynuclear neutrophil count; radiographic studies; preoperative aspiration; and specific radiolabeled markers of infection.	Our study indicates that CRP and joint aspiration are the most useful tools to diagnose PJI even in situations of chronic infection (Coventry type II).	3
70. Savarino L, Tigani D, Baldini N, Bochicchio V, Giunti A. Pre-operative diagnosis of infection in total knee arthroplasty: an algorithm. <i>Knee Surg Sports Traumatol Arthrosc</i> . 2009;17(6):667-675.	Observational-Dx	31 patients	To construct an algorithm for the preoperative diagnosis of infection in TKA.	The combination of at least 2 tests with values higher than the cutoffs is reliable for predicting the infection. Scintigraphy, needle-aspirate cell count and culture can integrate the preoperative evaluation. Doubtful cases can be clarified by microbiological and histological analyses. As a result an algorithm helpful to identify the cause of loosening has been developed.	3
71. Di Cesare PE, Chang E, Preston CF, Liu CJ. Serum interleukin-6 as a marker of periprosthetic infection following total hip and knee arthroplasty. <i>J Bone Joint Surg Am</i> . 2005;87(9):1921-1927.	Observational-Dx	58 patients	To determine whether assessment of the interleukin-6 level can be used to detect periprosthetic infection by studying a series of patients who were undergoing a reoperation at the site of a previous THA and TKA.	The serum interleukin-6 level, ESR, and CRP level were significantly higher in patients who had an infection than in those who did not, both when all patients were considered together and when the THA and TKA groups were considered separately. With the numbers available, there was no significant difference with regard to the WBC count between patients with and without infection. With a normal serum interleukin-6 level defined as <10 pg/mL, the serum interleukin-6 test had a sensitivity, specificity, PPV, NPV, and accuracy of 1.0%, 0.95%, 0.89%, 1.0%, and 97%, respectively.	3

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
72. Bottner F, Wegner A, Winkelmann W, Becker K, Erren M, Gotze C. Interleukin-6, procalcitonin and TNF-alpha: markers of peri-prosthetic infection following total joint replacement. <i>J Bone Joint Surg Br.</i> 2007;89(1):94-99.	Observational-Dx	78 patients	To evaluate the diagnostic value of the WBC count, ESR, CRP, interleukin-6, tumor necrosis factor-alpha and procalcitonin for the diagnosis of deep infection of implants in patients with failed total joint replacement.	Intra-operative cultures showed that 21 patients had a septic and 57 an aseptic total joint replacement. The WBC count, the ESR and levels of CRP, interleukin-6, procalcitonin and tumor necrosis factor-alpha were measured in blood samples before operation. The diagnostic cut-off values were determined by ROC curve analysis. CRP (>3.2 md/dL) and interleukin-6 (>12 pg/mL) have the highest sensitivity (0.95). Interleukin-6 is less specific than CRP (0.87 vs 0.96). Combining CRP and interleukin-6 identifies all patients with deep infection of the implant. Procalcitonin (>0.3 ng/mL) and tumor necrosis factor-alpha (>40 ng/mL) are very specific (0.98 vs 0.94) but have a low sensitivity (0.33 vs 0.43).	2
73. Bauer TW, Parvizi J, Kobayashi N, Krebs V. Diagnosis of periprosthetic infection. <i>J Bone Joint Surg Am.</i> 2006;88(4):869-882.	Review/Other-Dx	N/A	A review on tests used to diagnose periprosthetic infections.	No results stated in abstract.	4
74. Deirmengian C, Kardos K, Kilmartin P, Cameron A, Schiller K, Parvizi J. Diagnosing periprosthetic joint infection: has the era of the biomarker arrived? <i>Clin Orthop Relat Res.</i> 2014;472(11):3254-3262.	Observational-Dx	95 patients	To evaluate the diagnostic characteristics of 16 promising synovial fluid biomarkers for the diagnosis of PJI.	5 biomarkers, including human alpha-defensin 1-3, neutrophil elastase 2, bactericidal/permeability-increasing protein, neutrophil gelatinase-associated lipocalin, and lactoferrin, correctly predicted the MSIS classification of all patients in this study, with 100% sensitivity and specificity for the diagnosis of PJI. An additional 8 biomarkers demonstrated excellent diagnostic strength, with an area under the curve of >0.9.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
75. Deirmengian C, Kardos K, Kilmartin P, Cameron A, Schiller K, Parvizi J. Combined measurement of synovial fluid alpha-Defensin and C-reactive protein levels: highly accurate for diagnosing periprosthetic joint infection. <i>J Bone Joint Surg Am.</i> 2014;96(17):1439-1445.	Observational-Dx	149 patients	To evaluate the combined measurement of the levels of 2 synovial fluid biomarkers, alpha-defensin and CRP, for the diagnosis of PJI.	The combination of synovial fluid alpha-defensin and CRP tests demonstrated a sensitivity of 97% and a specificity of 100% for the diagnosis of PJI. Synovial fluid alpha-defensin tests alone demonstrated a sensitivity of 97% and a specificity of 96% for the diagnosis of PJI. Synovial fluid CRP tests, with a low threshold of 3 mg/L, reversed all-false positive alpha-defensin results without affecting the sensitivity of the test. The diagnostic characteristics of these assays were achieved in a population of patients demonstrating a 23% rate of systemic inflammatory diseases (in the series as a whole) and a 27% rate of concurrent antibiotic treatment (in the infection group). The synovial fluid levels of alpha-defensin in the setting of PJI were unchanged during concurrent antibiotic treatment.	3
76. Deirmengian C, Kardos K, Kilmartin P, Gulati S, Citrano P, Booth RE, Jr. The Alpha-defensin Test for Periprosthetic Joint Infection Responds to a Wide Spectrum of Organisms. <i>Clin Orthop Relat Res.</i> 2015;473(7):2229-2235.	Observational-Dx	1937 samples	To describe the breadth of organisms that can trigger a positive synovial fluid alpha-defensin test result in the setting of PJI and also to assess the magnitude of the alpha-defensin result in terms of various pathogen characteristics.	The alpha-defensin test for PJI was positive in the setting of a wide spectrum of organisms typically causing PJI. The median alpha-defensin level for all 244 alpha-defensin-positive, culture-positive samples (4.7 [IQR, 3.7-5.3]) was higher than negative controls (0.26 [IQR, 0.22-0.33]) with a median difference of 4.4 ($P<0.001$). There were no differences in the median alpha-defensin levels when performing a multiple comparison test among Gram-positive organisms (4.7 [IQR, 3.6-5.3]), Gram-negative organisms (4.8 [IQR, 4.2-5.3]), yeast (4.1 [IQR, 2.2-5.1]), virulent organisms (4.7 [IQR, 3.8-5.2]), less virulent organisms (4.8 [IQR, 3.6-5.4]), oral pathogens (4.5 [IQR, 3.2-5.2]), knees (4.7 [IQR, 3.7-5.3]), hips (4.9 [IQR, 4.1-5.8]), or shoulders (5.3 [IQR, 4.0-10.7]) with all comparisons having a $P>0.999$.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
77. Miller TT. Imaging of knee arthroplasty. <i>Eur J Radiol.</i> 2005;54(2):164-177.	Review/Other-Dx	N/A	To review the appearance of normal knee arthroplasty and the appearances of complications such as infection, polyethylene wear, aseptic loosening and particle-induced osteolysis, patellofemoral abnormalities, axial instability, and periprosthetic and component fracture.	Knowledge of the potential complications and their imaging appearances will help the radiologist in the diagnostic evaluation of the patient with a painful knee arthroplasty.	4
78. Squire MW, Della Valle CJ, Parvizi J. Preoperative diagnosis of periprosthetic joint infection: role of aspiration. <i>AJR Am J Roentgenol.</i> 2011;196(4):875-879.	Review/Other-Dx	N/A	To illustrate how TKA and THA aspiration by the radiologist can assist the health care team in determining the presence or absence of peri-PJI.	The increasing incidence of periprosthetic TKA and THA infection, as well as the changing role of aspiration for diagnosing peri-PJI, will likely increase demand for this important procedure in the future.	4
79. Chimento GF, Finger S, Barrack RL. Gram stain detection of infection during revision arthroplasty. <i>J Bone Joint Surg Br.</i> 1996;78(5):838-839.	Observational-Dx	194 revision arthroplasties of the hip and knee	To correlate the results of Gram staining performed on swabs taken during revision hip and knee arthroplasty on patients with known clinical infection to determine the accuracy of the prediction of infection.	The results of intraoperative Gram staining were available in 169 (87%). 32 were found to be infected (11 hips and 21 knees) and 137 had no evidence of infection. Intraoperative Gram staining was negative in all 169 cases. The method therefore had a sensitivity of 0% for detecting infection. We conclude that the absence of organisms on intraoperative Gram staining during revision arthroplasty does not confirm the absence of infection.	3
80. Mason JB, Fehring TK, Odum SM, Griffin WL, Nussman DS. The value of white blood cell counts before revision total knee arthroplasty. <i>J Arthroplasty.</i> 2003;18(8):1038-1043.	Observational-Dx	86 patients	To define the diagnostic value of preoperative aspiration with respect to WBC count and differentials.	Of 440 revision TKAs, 86 patients had preoperative aspirations of the knee before revision. 55 aspirates were from aseptic failures; 31 aspirates were from patients determined to have septic failure. The mean WBC count in aspirates from the aseptic group was 645 cells/mm ³ (SD = 878). The mean WBC count in the septic group was 25951 cells/mm ³ (SD = 34994; $P \leq .001$). The mean percentage of polymorphonuclear cells was statistically higher in the septic group compared with the aseptic group (72.8% vs 27.3%; $P \leq .001$). The synovial fluid WBC count differential analysis is a statistically relevant indicator of the presence or absence of infection in revision knee arthroplasty. Aspirates with a WBC count of 2500/mL and 60% polymorphonuclear cells are highly suggestive of infection.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
81. Trampuz A, Hanssen AD, Osmon DR, Mandrekar J, Steckelberg JM, Patel R. Synovial fluid leukocyte count and differential for the diagnosis of prosthetic knee infection. <i>Am J Med.</i> 2004;117(8):556-562.	Observational-Dx	133 patients	To define cutoff values for synovial fluid leukocyte count and neutrophil percentage for differentiating aseptic failure and PJI.	Aseptic failure was diagnosed in 99 patients and PJI was diagnosed in 34 patients. The synovial fluid leukocyte count was significantly higher in patients with PJI (median, 18.9 x 10(3)/microL; range, 0.3 to 178 x 10(3)/microL) than in those with aseptic failure (median, 0.3 x 10(3)/microL; range, 0.1 to 16 x 10(3)/microL; $P<0.0001$); the neutrophil percentage was also significantly higher in patients with PJI (median [range], 92% [55% to 100%] vs 7% [0% to 79%], $P<0.0001$). A leukocyte count of $>1.7 \times 10(3)/\text{microL}$ had a sensitivity of 94% and a specificity of 88% for diagnosing PJI; a differential of $>65\%$ neutrophils had a sensitivity of 97% and a specificity of 98%. <i>Staphylococcus aureus</i> was the only pathogen associated with leukocyte counts $>100 \times 10(3)/\text{microL}$.	3
82. Toms AD, Davidson D, Masri BA, Duncan CP. The management of peri-prosthetic infection in total joint arthroplasty. <i>J Bone Joint Surg Br.</i> 2006;88(2):149-155.	Review/Other-Dx	N/A	To update and summarize the recent refinements in diagnosis and the subsequent results of treatment.	No results stated in abstract.	4
83. Ali F, Wilkinson JM, Cooper JR, et al. Accuracy of joint aspiration for the preoperative diagnosis of infection in total hip arthroplasty. <i>J Arthroplasty.</i> 2006;21(2):221-226.	Observational-Dx	73 patients	To assess the diagnostic accuracy of radiology department-based hip aspiration for the diagnosis of infection after THA.	17 patients (23%) had infected hip joints at operative culture. The sensitivity and specificity, PPV and NPV, and accuracy of the hip aspiration were 0.82 and 0.91, 0.74 and 0.94, and 0.89, respectively.	3

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
84. Barrack RL, Jennings RW, Wolfe MW, Bertot AJ. The Coventry Award. The value of preoperative aspiration before total knee revision. <i>Clin Orthop Relat Res.</i> 1997(345):8-16.	Observational-Dx	69 knees in 67 patients	To evaluate the value of routine aspiration of a symptomatic TKR before reoperation.	20 knees were determined to be infected and 49 knees were not infected. Preoperative aspiration had an overall sensitivity of 55%, specificity of 96%, accuracy of 84%, PPV of 85%, and NPV of 84%. 16 patients were taking antibiotics at the time of referral including 12/20 (60%) who had infected knees. 7 of these 12 (58%) had no growth on their initial knee aspiration. 4 of these had their knees reaspirated at a later date because of a high index of suspicion for infection and the subsequent aspiration revealed the infecting organism in all 4 cases. 2 of the remaining 3 patients had signs of sepsis develop and reaspiration was not performed because immediate reoperation was indicated clinically. The initial aspiration on the third patient was performed after antibiotic therapy was discontinued for 4 weeks and a repeat aspiration was not deemed necessary. When the results of the reaspirations are included, the overall aspiration results improved to a sensitivity of 75%, specificity of 96%, and accuracy of 90%.	3
85. Della Valle CJ, Sporer SM, Jacobs JJ, Berger RA, Rosenberg AG, Paprosky WG. Preoperative testing for sepsis before revision total knee arthroplasty. <i>J Arthroplasty.</i> 2007;22(6 Suppl 2):90-93.	Observational-Dx	105 arthroplasties	To report on the utility of commonly available tests for determining periprosthetic infection of the knee in a consecutive series of revision TKAs that all underwent a consistent protocol for evaluating infection with a specific focus on the use of the synovial fluid WBC count.	A synovial fluid WBC count of >3000 was the most precise test with a sensitivity of 100%, specificity of 98%, and accuracy of 99%. The preoperative use of an ESR and CRP proved to be an excellent screening modality with only 1 infection identified with both values being normal.	3

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
86. Marx A, Saxler G, Landgraaber S, Loer F, Holland-Letz T, von Knoch M. Comparison of subtraction arthrography, radionuclide arthrography and conventional plain radiography to assess loosening of total knee arthroplasty. <i>Biomed Tech (Berl)</i> . 2005;50(5):143-147.	Observational-Dx	23 failed TKAs	To analyze the accuracy of the 3 techniques to detect a loose femoral or tibial component.	At revision we found 13 loose femoral and 12 loose tibial implants. In 8 cases both components were unstable. Plain radiography had a sensitivity of 77% for loosening of the femoral and 83% for the tibial component; digital subtraction arthrography 77% for the femoral and 8% for the tibial component and radionuclide arthrography 31% and 8%. The specificity for plain radiography was 90% for the femoral and 72% for the tibial implant. For subtraction arthrography it was 50% and 82% and for subtraction arthrography 70% and 82%. Radiography had the highest PPV and NPV for both components compared with the other 2 techniques.	3
87. Reish TG, Clarke HD, Scuderi GR, Math KR, Scott WN. Use of multi-detector computed tomography for the detection of periprosthetic osteolysis in total knee arthroplasty. <i>J Knee Surg</i> . 2006;19(4):259-264.	Observational-Dx	31 patients	To determine the accuracy of plain radiography in detecting osteolytic lesions around total knee prostheses compared to multidetector CT.	The multidetector CT detected 48 lesions in 31 knees: 40 tibial lesions, 4 femoral lesions, and 4 patellar lesions. Radiographic diagnosis was made in 6 of the 40 tibial lesions, 2 of the 4 femoral lesions, and 0 of the 4 patellar lesions. Plain radiographs are inadequate for evaluating periprosthetic osteolysis in TKA with only 8 (17%) of 48 lesions detected by multidetector CT visible on the standard radiographs.	3
88. Mosher TJ, Davis CM, 3rd. Magnetic resonance imaging to evaluate osteolysis around total knee arthroplasty. <i>J Arthroplasty</i> . 2006;21(3):460-463.	Review/Other-Dx	2 cases	To describe the use of MRI to identify particulate-induced osteolysis around the distal femur and proximal tibia in 2 patients with TKAs.	The extent of the osteolysis was not apparent from standard x-rays, and the information provided by the MRI facilitated preoperative discussion with the patient as well as preoperative planning for the surgery.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
89. Gemmel F, Van den Wyngaert H, Love C, Welling MM, Gemmel P, Palestro CJ. Prosthetic joint infections: radionuclide state-of-the-art imaging. <i>Eur J Nucl Med Mol Imaging</i> . 2012;39(5):892-909.	Review/Other-Dx	N/A	To review the drawbacks and limitations inherent to each modality.	Bone scintigraphy is sensitive for identifying the failed joint replacement, but cannot differentiate between infection and aseptic loosening. Combined bone/gallium scintigraphy offers modest improvement over bone scintigraphy alone for diagnosing PJI. However, due to a number of drawbacks, bone/gallium scintigraphy has generally been superseded by other techniques but it still may have a role in neutropenic patients. Radiolabeled leucocyte scintigraphy remains the gold standard technique for diagnosing neutrophil-mediated processes. It seems to be that combined in vitro labelled leucocyte/bone marrow scintigraphy, with an accuracy of about 90%, is currently the imaging modality of choice for diagnosing PJI. There are, however, significant limitations using in vitro labelled leucocytes and considerable effort has been devoted to developing alternative radiotracers, such as radiolabeled HIGs, liposomes, antigranulocyte antibodies and fragments, as well as more investigational tracers such as radiolabeled antibiotics, antimicrobial peptides, bacteriophages and thymidine kinase. On the other hand, PET is still growing in the field of PJI imaging with radiotracers such as FDG, FDG WBCs and (18)F-fluoride. But unfortunately this superb tomographic technique will only receive full acceptance when specific PET uptake patterns can be successfully developed. The emergence of hybrid modality imaging using integrated SPECT and PET with CT (SPECT/CT and PET/CT) may also have a contributing role for more accurate assessment of joint replacement complications, especially combined with new radiotracers such as (68)Ga and (64)Cu. Finally, in searching for infection-specific tracers, currently there is no such diagnostic agent available.	4

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
90. Smith SL, Wastie ML, Forster I. Radionuclide bone scintigraphy in the detection of significant complications after total knee joint replacement. <i>Clin Radiol.</i> 2001;56(3):221-224.	Observational-Dx	75 patients	To determine the usefulness of Tc-99m methylene diphosphonate bone scintigraphy.	75 patients with painful knee arthroplasties were referred for investigation. A total of 80 bone scintigrams were performed. The average patient age was 66.2 years (42 female and 33 male). The mean time period between surgery and onset of knee pain was 3 years. A final clinical diagnosis based on arthroscopy, open surgery, and extended clinical follow-up was available for all patients. 43 (53.8%) of the scintigrams were normal and 37 (46.3%) abnormal. 2 patients with a normal bone scintigram has loose prostheses. 13 patients with an abnormal study had normal prostheses on follow-up and these tended to be patients scanned less than a year after surgery. The sensitivity, specificity, PPV and NPV of an unequivocally normal or abnormal bone scintigram was 92.3%, 75.9%, 64.9% and 95.0%, respectively. The pattern of isotope uptake in the abnormal studies was not specific enough to reliably differentiate aseptic from septic loosening.	3
91. Duus BR, Boeckstyns M, Stadeager C. The natural course of radionuclide bone scanning in the evaluation of total knee replacement--a 2 year prospective study. <i>Clin Radiol.</i> 1990;41(5):341-343.	Observational-Dx	41 patients	To establish the natural course of radionuclide bone scanning images after TKR.	No significant difference between the grades of total scintigraphic uptake at any of the 4 examinations nor any difference between the first and the last examinations could be demonstrated ($P=0.58$, Friedman test and $P=0.20$, Wilcoxon test, respectively). 12 months after surgery one-fifth of the knees still demonstrated definitely increased scintigraphic uptake and 24 months after surgery 12.5% of the knees had definitely increased uptake.	2

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
92. Kantor SG, Schneider R, Insall JN, Becker MW. Radionuclide imaging of asymptomatic versus symptomatic total knee arthroplasties. <i>Clin Orthop Relat Res.</i> 1990(260):118-123.	Observational-Dx	98 knee prostheses	To compare symptomatic and asymptomatic knee prostheses as well as those knees that are symptomatic, without abnormal roentgenograms that have not been revised.	At a mean of 54 months, asymptomatic knee replacements generally showed only mild uptake in 1 or more zones. Only 1 knee had uptake equal to surrounding bone. However, symptomatic knee replacements showed significantly greater uptake in the patella, femur, and medial and lateral tibial plateau regions (Mann-Whitney two-sample rank test). Bone scans in the symptomatic group were obtained at a mean of 44 months. Excluding those patients who had revision surgery, the differences remained significant. Furthermore, symptomatic knee replacements with normal roentgenograms also had significantly greater uptake. Radiolucent lines were noted in 30% of asymptomatic patients, whereas 29% of symptomatic knees had radiolucencies. Radiolucencies were not generally associated with significantly greater uptake. Lateral release had no effect on the patellar score.	3
93. Garvin KL, Konigsberg BS. Infection following total knee arthroplasty: prevention and management. <i>J Bone Joint Surg Am.</i> 2011;93(12):1167-1175.	Review/Other-Tx	N/A	No abstract available.	No abstract available.	4
94. Reinartz P. FDG-PET in patients with painful hip and knee arthroplasty: technical breakthrough or just more of the same. <i>Q J Nucl Med Mol Imaging.</i> 2009;53(1):41-50.	Review/Other-Dx	N/A	To evaluate the pooled data of the major publications in the English literature analyzing the accuracy of the triple-phase bone scan, WBC imaging and PET.	Triple-phase bone scan yielded the least favorable results with an accuracy of 80% for hip prostheses and 81% for knee arthroplasty. PET finished second with values of 89% (hip) and 83% (knee), respectively. WBC imaging exceeded the results of triple-phase bone scan and PET, yielding values of 91% (hip) and 84% (knee). Although bested by WBC imaging, PET is still highly attractive since it combines several of the positive aspects of the 2 other methods. Its accuracy is only slightly lower than that of WBC imaging while at the same time it provides most of the comfort of the bone scan: only 1 injection, no processing of blood samples and the results are available within 4 hours.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
95. Love C, Marwin SE, Palestro CJ. Nuclear medicine and the infected joint replacement. <i>Semin Nucl Med.</i> 2009;39(1):66-78.	Review/Other-Dx	N/A	To review hip and knee arthroplasties and differentiate aseptic loosening, the most common cause of prosthetic joint failure, from infection.	No results stated in abstract.	4
96. Palestro CJ. Nuclear medicine and the failed joint replacement: Past, present, and future. <i>World J Radiol.</i> 2014;6(7):446-458.	Review/Other-Dx	N/A	To provide a comprehensive review of the evolution of nuclear medicine imaging of joint replacements.	Advances in anatomic imaging, notably cross sectional modalities, have facilitated the diagnosis of many, if not most, causes of prosthetic failure, with the important exception of infection. This has led to a shift in the diagnostic paradigm, in which nuclear medicine investigations increasingly have focused on diagnosing infection. The recognition that bone scintigraphy could not reliably diagnose infection led to the development of combined studies, first bone/gallium and subsequently leukocyte/bone and leukocyte/marrow imaging. Labeled leukocyte imaging, combined with bone marrow imaging is the most accurate (about 90%) imaging test for diagnosing joint arthroplasty infection. FDG-PET has been extensively investigated for more than a decade but its role in diagnosing the infected prosthesis has yet to be established. Although for many years nuclear medicine has focused on diagnosing prosthetic joint infection, the advent of hybrid imaging with SPECT/CT and the availability of fluorine-18 fluoride PET suggests that the diagnostic paradigm may be shifting again. By providing the anatomic information lacking in conventional radionuclide studies, there is renewed interest in bone scintigraphy, performed as a SPECT/CT procedure, for detecting joint instability, mechanical loosening and component malpositioning. Fluoride-PET may provide new insights into periprosthetic bone metabolism.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
97. Pring DJ, Henderson RG, Rivett AG, Krausz T, Coombs RR, Lavender JP. Autologous granulocyte scanning of painful prosthetic joints. <i>J Bone Joint Surg Br.</i> 1986;68(4):647-652.	Observational-Dx	60 patients with 74 prosthetic joints	To describe the technique of In-111 granulocyte scanning in assessing painful prosthetic joints and give our results.	All 18 patients with confirmed sepsis had positive scans, that is, migration of granulocytes into the region of the prosthesis. Of the 22 sterile arthroplasties 20 had negative scans. In 34 cases there was good correlation between the clinical impression and the result of the scan.	4
98. Scher DM, Pak K, Lonner JH, Finkel JE, Zuckerman JD, Di Cesare PE. The predictive value of indium-111 leukocyte scans in the diagnosis of infected total hip, knee, or resection arthroplasties. <i>J Arthroplasty.</i> 2000;15(3):295-300.	Observational-Dx	153 scans on 143 patients	To determine the sensitivity, specificity, PPV and NPV, and accuracy of In-111 scanning in the diagnosis of infected total hip, total knee, and resection arthroplasties.	In-111 scans were found to have a 77% sensitivity, 86% specificity, 54% and 95% PPV and NPV, and 84% accuracy for the prediction of infection. Of 6 equivocal scans, none were infected.	3
99. Glithero PR, Grigoris P, Harding LK, Hesselewood SR, McMinn DJ. White cell scans and infected joint replacements. Failure to detect chronic infection. <i>J Bone Joint Surg Br.</i> 1993;75(3):371-374.	Observational-Dx	52 patients with 54 prostheses	To present our experience of using both In-oxine and Tc-HMPAO-labelled white-cell scans in the detection of infection in failed joint prostheses.	13 hips and 5 knees proved to be infected. The scans taken together had an accuracy of 82%, a sensitivity of 44% and a specificity of 100%. Indium scans gave 37% sensitivity, Tc-99m labelling 50% sensitivity. Infected arthroplasties with positive scans had presented significantly earlier than those with negative scans, the time after the original insertion being 1.1 years for the true-positive scans and 6.1 years for the false-negative scans.	3
100. Rand JA, Brown ML. The value of indium 111 leukocyte scanning in the evaluation of painful or infected total knee arthroplasties. <i>Clin Orthop Relat Res.</i> 1990(259):179-182.	Observational-Dx	38 patients	To determine the value of In-111 leukocyte scanning for determining deep infection in the patient with a painful TKA.	The scan had an accuracy of 84%, a sensitivity of 83%, and a specificity of 85%.	3
101. Rosas MH, Leclercq S, Pegoix M, et al. Contribution of laboratory tests, scintigraphy, and histology to the diagnosis of lower limb joint replacement infection. <i>Rev Rhum Engl Ed.</i> 1998;65(7-9):477-482.	Observational-Dx	37 lower limb arthroplasties	To evaluate the contribution of laboratory tests, histology and scintigraphy for diagnosing and monitoring the treatment of lower limb arthroplasty infection.	Acute phase reactants were more sensitive and more specific than the ESR. The full scintigraphy protocol had 100% sensitivity and 87% specificity. Recovery of neutrophils by aspiration or during surgery was 100% specific in the absence of hematomas or rheumatoid arthritis. Sensitivity of the presence of neutrophils varied with the collection technique.	4

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
102. Teller RE, Christie MJ, Martin W, Nance EP, Haas DW. Sequential indium-labeled leukocyte and bone scans to diagnose prosthetic joint infection. <i>Clin Orthop Relat Res.</i> 2000(373):241-247.	Observational-Dx	166 cases	To compare sequential Tc-99-hydroxymethyl diphosphonate and In-111 leukocyte scintigraphy with other clinical predictors of infection and to validate the previous analysis in a much larger study population.	Sequential Tc-99-hydroxymethyl diphosphonate and In-111 leukocyte imaging was 64% sensitive and 78% specific. Fever, physical findings, or sedimentation rate did not identify infection reliably, and preoperative aspirate culture was only 28% sensitive. Positive scintigraphy increased the likelihood of finding infection intraoperatively from 14% to 30%, although negative scintigraphy decreased this likelihood to 7%.	3
103. Filippi L, Schillaci O. Usefulness of hybrid SPECT/CT in 99mTc-HMPAO-labeled leukocyte scintigraphy for bone and joint infections. <i>J Nucl Med.</i> 2006;47(12):1908-1913.	Observational-Dx	28 patients	To evaluate the usefulness of SPECT and transmission CT performed simultaneously using a hybrid imaging device for the functional anatomic mapping of bone and joint infections.	Tc-99m-HMPAO scintigraphy was true-positive for infection in 18/28 patients (for a total of 21 sites of uptake) and true-negative in 10/28 subjects. SPECT/CT provided an accurate anatomic localization of all positive foci. With regard to the final diagnosis, SPECT/CT added a significant clinical contribution in 10/28 patients (35.7%). In fact, SPECT/CT differentiated soft-tissue from bone involvement both in patients with osteomyelitis and in patients with orthopedic implants, allowed correct diagnosis of osteomyelitis in patients with structural alterations after trauma, and identified synovial infection without prosthesis involvement in patients with a knee implant.	2
104. Love C, Tronco G, Yu A, Marwin S, Nichols K, Palestro C. Diagnosing lower extremity (LE) prosthetic joint infection: Bone, gallium & labeled leukocyte imaging. <i>Journal of Nuclear Medicine.</i> 2008;49(supplement 1):133P.	Observational-Dx	150 failed prosthetic joints	To compare 3-phase bone, bone, gallium, bone/gallium, WBC, WBC/bone, and WBC/marrow for diagnosing lower extremity PJI.	67 (45%) prostheses were infected, 67 (45%) aseptically loosened, 16 (10%) miscellaneous. 3-phase bone, bone, and bone/gallium were moderately sensitive; gallium, WBC, WBC/Bone, & WBC/Marrow were highly sensitive. WBC/Marrow was significantly more specific ($P \leq 0.0001$) than all other tests.	3
105. Zhuang H, Duarte PS, Pourdehnad M, et al. The promising role of 18F-FDG PET in detecting infected lower limb prosthesis implants. <i>J Nucl Med.</i> 2001;42(1):44-48.	Observational-Dx	74 prostheses in 62 patients	To evaluate the feasibility of using FDG-PET for the detection of infection associated with lower limb arthroplasty.	The sensitivity, specificity, and accuracy of PET for detecting infection associated with knee prostheses were 90.9%, 72.0%, and 77.8%, respectively. The sensitivity, specificity, and accuracy of PET for detecting infection associated with hip prostheses were 90%, 89.3%, and 89.5%, respectively. Overall, the sensitivity was 90.5% and the specificity was 81.1% for detection of lower limb infections.	3

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
106. Van Acker F, Nuyts J, Maes A, et al. FDG-PET, 99mTc-HMPAO white blood cell SPET and bone scintigraphy in the evaluation of painful total knee arthroplasties. <i>Eur J Nucl Med.</i> 2001;28(10):1496-1504.	Observational-Dx	21 symptomatic patients, 17 unsymptomatic patients	To establish the clinical value of FDG-PET in comparison to WBC scintigraphy, in combination with the three-phase bone scan, in patients with a painful TKA.	In the infected TKAs, the WBC scan showed focal activity of grade 2 (n=2), 3 (n=1) or 4 (n=2). PET scan revealed focal activity of grade 4 (n=5) or 3 (n=1). WBC scan alone had a specificity for infection of 53% [PPV 42%, sensitivity 100%], compared with 73% for PET scan (PPV 60%, sensitivity 100%). Considering only lesions at the bone-prosthesis interface that were also present on the third phase of the bone scan, we found a specificity of 93% (PPV 83%) for WBC scan. Using these criteria, a specificity of 80% (PPV 67%) was obtained for PET scan. 2 out of 3 false-positive PET scans were due to loosening of the TKA.	2
107. Manthey N, Reinhard P, Moog F, Knesewitsch P, Hahn K, Tatsch K. The use of [18 F]fluorodeoxyglucose positron emission tomography to differentiate between synovitis, loosening and infection of hip and knee prostheses. <i>Nucl Med Commun.</i> 2002;23(7):645-653.	Observational-Dx	23 patients with 28 prostheses, 14 hip and 14 knee prostheses	To describe FDG-PET findings in patients referred for evaluation of painful hip or knee prostheses.	PET correctly identified 3 hip and 1 knee prostheses as infected, 2 hip and 2 knee prostheses as loosening, 3 hip and 9 knee prostheses as synovitis, and 2 hip and 1 knee prostheses as unsuspected for loosening or infection. In 3 patients covered with an expander after explanation of an infected prosthesis, PET revealed no further evidence of infection in concordance with the clinical follow-up. PET was false negative for loosening in 1 case.	3
108. Kwee TC, Kwee RM, Alavi A. FDG-PET for diagnosing prosthetic joint infection: systematic review and metaanalysis. <i>Eur J Nucl Med Mol Imaging.</i> 2008;35(11):2122-2132.	Meta-analysis	11 studies; 635 prostheses	To systematically review and meta-analysis published data on the diagnostic performance of FDG-PET in detecting prosthetic hip or knee joint infection.	The inclusion criteria were met by 11 studies; there was a total sample size of 635 prostheses. Overall, the studies had good methodological quality. Pooled sensitivity and specificity of FDG-PET for the detection of prosthetic hip or knee joint infection were 82.1% (95% CI = 68.0%–90.8%) and 86.6% (95% CI = 79.7%–91.4%), respectively. Heterogeneity among the results of individual studies was present (I (2) = 68.8%). Diagnostic performance was influenced by type of joint prostheses (hip prostheses vs knee prostheses) and type of reconstruction method used (filtered back vs iterative) (P=0.0164 and P=0.0235, respectively).	M

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
109. Delank KS, Schmidt M, Michael JW, Dietlein M, Schicha H, Eysel P. The implications of 18F-FDG PET for the diagnosis of endoprosthetic loosening and infection in hip and knee arthroplasty: results from a prospective, blinded study. <i>BMC Musculoskelet Disord.</i> 2006;7:20.	Observational-Dx	27 patients	To evaluate the clinical value of FDG-PET as a diagnostic modality for inflammation and loosening in hip and knee joint prostheses.	Evidence of loosening was correctly determined in 76.4% of cases using FDG-PET, and in 75% of cases using bone scan. The detection of periprosthetic inflammation using FDG-PET had sensitivity of 100% for septic cases and of 45.5% in cases of increased abrasion and aseptic foreign-body reactions. However, reliable differentiation between abrasion-induced and bacterial-caused inflammation was not possible using FDG-PET.	3
110. Prandini N, Lazzeri E, Rossi B, Erba P, Parisella MG, Signore A. Nuclear medicine imaging of bone infections. <i>Nucl Med Commun.</i> 2006;27(8):633-644.	Meta-analysis	89 studies: peripheric post-traumatic and PJI	To conduct a meta-analysis of the use of nuclear medicine imaging for the study of the most frequent causes of bone infections, including prosthetic joint, peripheric post-traumatic bone infections, vertebral and sternal infections.	Results not stated in abstract.	M
111. Aksoy SY, Asa S, Ozhan M, et al. FDG and FDG-labelled leucocyte PET/CT in the imaging of prosthetic joint infection. <i>Eur J Nucl Med Mol Imaging.</i> 2014;41(3):556-564.	Observational-Dx	46 patients, 54 prostheses	To evaluate the role of FDG-PET/CT and FDG-labelled leucocyte PET/CT in the diagnosis of periprosthetic infection.	The final diagnosis showed infection in 15 (28%) and aseptic loosening in 39 (72%) of the 54 prostheses. FDG-PET/CT was found to have a PPV of 28% (15/54). Since patients with no FDG uptake on FDG-PET/CT were excluded from the study, the sensitivity, specificity, NPV and accuracy could not be calculated. The sensitivity, specificity, and PPV and NPV of FDG-labelled leucocyte PET/CT were 93.3% (14/15), 97.4% (38/39), 93.3% and 97.4%, respectively.	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
112. Chacko TK, Zhuang H, Nakhoda KZ, Moussavian B, Alavi A. Applications of fluorodeoxyglucose positron emission tomography in the diagnosis of infection. <i>Nucl Med Commun.</i> 2003;24(6):615-624.	Observational-Dx	167 scans to evaluate 175 potential sites of infection	To assess the accuracy of FDG-PET in diagnosing infection in a large population of patients and in a variety of clinical circumstances where the performance of conventional imaging modalities has been questioned.	The overall accuracy of FDG-PET in evaluating orthopedic hardware was 96.2% for hip prosthesis, 81% for knee prosthesis, and 100% in 15 patients with other orthopedic devices. Among the patients in the sample suspected of having chronic osteomyelitis, the accuracy was 91.2%. FDG-PET was inaccurate in 3 cases of fever of unknown origin and accurate in all vascular graft and soft tissue infections. In 49 patients with a clinically apparent soft-tissue infection, FDG-PET was able to detect or exclude underlying osteomyelitis with an accuracy of 92.3%. Among the 23 patients who had recent orthopedic procedures, FDG-PET imaging was accurate in 87% of cases.	3
113. Schober O, Heindel W. <i>PET-CT Hybrid Imaging</i> . 1st ed. Stuttgart/New York: Thieme; 2008.	Review/Other-Dx	N/A	Book.	N/A	4
114. Sterner T, Pink R, Freudenberg L, et al. The role of [18F]fluoride positron emission tomography in the early detection of aseptic loosening of total knee arthroplasty. <i>Int J Surg.</i> 2007;5(2):99-104.	Observational-Dx	14 arthroplasties	To evaluate the usefulness of [18F]fluoride PET in symptomatic TKA to detect early aseptic loosening.	We found a sensitivity of 100%, a specificity of 56% and an accuracy of 71%. No false negative results were detected, in 4 patient's 1 component as false positive. The sensitivity, specificity and accuracy for the plain radiograph of the same patients were 43%, 86% and 64%, respectively.	3

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
115. Stumpe KD, Romero J, Ziegler O, et al. The value of FDG-PET in patients with painful total knee arthroplasty. <i>Eur J Nucl Med Mol Imaging</i> . 2006;33(10):1218-1225.	Review/Other-Dx	28 patients	To evaluate FDG uptake in patients with painful TKA and to relate FDG uptake to the location of soft tissue pain.	27 of 28 patients presented with diffuse synovial FDG uptake. Additional focal extrasynovial FDG uptake was observed in 19 knees. 24 of the 28 patients had a diagnosis of internal femoral malrotation. The remaining 4 patients showed no rotation (0 degrees) and 3 degrees, 4 degrees and 7 degrees of external rotation, respectively. 3 patients presented with the additional diagnosis of an infected TKR. Pain was described as diffuse (n=10) or focal (n=18). In 2 knees a relationship between pain location and FDG uptake was observed. Of 10 patients with a severe internal femoral component rotation (>6 degrees), 7 had focal uptake, 4 in the femoral periosteum and 3 in the tibial periosteum. The difference between knees with severe malrotation and the remaining knees was not significant ($P=1.000$, Fisher's Exact Test).	4
116. Zhuang H, Chacko TK, Hickeson M, et al. Persistent non-specific FDG uptake on PET imaging following hip arthroplasty. <i>Eur J Nucl Med Mol Imaging</i> . 2002;29(10):1328-1333.	Observational-Dx	9 prospective patients; 18 retrospective asymptomatic patients	To assess the patterns and time course of FDG accumulation following total hip replacement over an extended period of time.	During the entire study period, all 9 patients enrolled in the prospective study were demonstrated to have increased FDG uptake around the femoral head or neck portion of the prosthesis that extended to the soft tissues surrounding the femur. Among the patients reviewed in the retrospective study, 18 patients with a history of 21 hip arthroplasties who were asymptomatic at the time of FDG-PET scan met the criteria for inclusion. The time interval between the hip arthroplasty and the FDG-PET study ranged from 3 months to 288 months (mean \pm -SD: 80.4 \pm -86.2 months). In 81% (17/21) of these prostheses, increased FDG uptake could be noted around the femoral head or neck portion of the prosthesis. The average time interval between arthroplasty and FDG-PET scan in these patients was 71.3 months. In only 4 prostheses (19%, 4/21) was no abnormally increased FDG uptake seen around the prostheses or adjacent sites. The average time interval in these patients was 114.8 months	3

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
117. Bleeker-Rovers CP, Rennen HJ, Boerman OC, et al. 99mTc-labeled interleukin 8 for the scintigraphic detection of infection and inflammation: first clinical evaluation. <i>J Nucl Med.</i> 2007;48(3):337-343.	Observational-Dx	20 patients	To evaluate the safety of IL-8 in humans and to assess the value of Tc-99m-IL-8 scintigraphy in patients with suspected localized infections.	Tc-99m-IL-8 scintigraphy was performed for 20 patients (13 men and 7 women) with a mean age of 60 years (range, 21-76 years). No significant side effects were noted. Patients had suspected joint prosthesis infections (n = 9), osteomyelitis (n = 8), liver abscess (n = 1), and soft-tissue infections (n = 2). Tc-99m-IL-8 was rapidly cleared from the blood and most other organs. In 10/12 patients with infections, Tc-99m-IL-8 localized the infection at 4 hours after injection. In 1 patient with vertebral osteomyelitis and in 1 patient with an infected knee prosthesis, Tc-99m-IL-8 scintigraphy results were false-negative. In 8 patients with noninfectious disorders, no focal accumulation of Tc-99m-IL-8 was found.	2
118. Gratz S, Behr TM, Reize P, Pfestroff A, Kampen WU, Hoffken H. (99m)Tc-Fab' fragments (sulesomab) for imaging septicallly loosened total knee arthroplasty. <i>J Int Med Res.</i> 2009;37(1):54-67.	Observational-Dx	26 patients	To study the diagnostic accuracy of infection scintigraphy with Tc-99m-labelled monoclonal antibody Fab' fragments (sulesomab) in patients with suspected TKA infection.	Histologically, aseptic TKA loosening occurred in 2 patients and severe, moderate or mild septic loosening in 4, 9 and 11 patients, respectively. Diagnostic accuracy for severe infection was 100% for both readers, whereas for moderate infection accuracy decreased by 12% and 12% for readers 1 and 2, respectively. For mild infection a further decrease of approximately 61% and 52% occurred for readers 1 and 2, respectively. Quantitative evaluation gave significantly better results over visual interpretation with a diagnostic accuracy of 100% for severe infection and decreased by only 10% and 15% in patients with moderate and mild infection, respectively.	2
119. Dalury DF, Pomeroy DL, Gorab RS, Adams MJ. Why are total knee arthroplasties being revised? <i>J Arthroplasty.</i> 2013;28(8 Suppl):120-121.	Review/Other-Tx	820 revision TKAs, 693 patients	To report the reason(s) for revision TKA in a large, current, multicenter series and compare those reasons with previously published reasons.	The top 7 reasons for the revision were aseptic loosening (23.1%), infection (18.4%), polyethylene wear (18.1%), instability (17.7%), pain/stiffness (9.3%), osteolysis (4.5%), and malposition/malalignment (2.9%). Comparison with previously published reasons showed fewer TKA revisions for polyethylene wear, osteolysis, instability, and malalignment.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
120. Lombardi AV, Jr., Berend KR, Adams JB. Why knee replacements fail in 2013: patient, surgeon, or implant? <i>Bone Joint J.</i> 2014;96-B(11 Supple A):101-104.	Review/Other-Tx	844 revision TKRs	To report a detailed analysis of failure mechanisms over time and to see if failure modes have changed over the past 10 to 15 years.	Aseptic loosening was the predominant mechanism of failure (31.2%), followed by instability (18.7%), infection (16.2%), polyethylene wear (10.0%), arthrofibrosis (6.9%) and malalignment (6.6%). The mean time to failure was 5.9 years (10 days to 31 years), 35.3% of all revisions occurred at <2 years, and 60.2% in the first 5 years. With improvements in implant and polyethylene manufacture, polyethylene wear is no longer a leading cause of failure. Early mechanisms of failure are primarily technical errors.	4
121. Thiele K, Perka C, Matziolis G, Mayr HO, Sostheim M, Hube R. Current failure mechanisms after knee arthroplasty have changed: polyethylene wear is less common in revision surgery. <i>J Bone Joint Surg Am.</i> 2015;97(9):715-720.	Review/Other-Tx	358 TKA revisions	To clarify which underlying indications can be currently considered the main reasons for failure after TKA as a function of time.	358 revision TKAs were included. Of those revisions, 19.8% were performed within the first year after the index arthroplasty. The most common indications for revision, besides aseptic loosening (21.8%), were instability (21.8%), malalignment (20.7%), and periprosthetic infection (14.5%). Revisions due to polyethylene wear (7%) rarely occurred. In the early failure group, the primary causes of revision were periprosthetic infection (26.8%) and instability (23.9%). In the intermediate group, instability (23.3%) and malalignment (29.4%) required revision surgery, whereas late failure mechanisms were aseptic loosening (34.7%), instability (18.5%), and polyethylene wear (18.5%).	4
122. Fehring TK, McAvoy G. Fluoroscopic evaluation of the painful total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 1996(331):226-233.	Review/Other-Dx	20 patients	To review patients referred for pain and disability after TKA with normal appearing office radiographs.	In 14 of the 20 patients, the diagnosis of aseptic loosening was made with fluoroscopically guided radiographs. Each patient thought to have a loose component at fluoroscopy did, in fact, have a loose component at revision. Each patient improved after revision with an average increase in the Hospital for Special Surgery score of 26 points.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
123. Mintz AD, Pilkington CA, Howie DW. A comparison of plain and fluoroscopically guided radiographs in the assessment of arthroplasty of the knee. <i>J Bone Joint Surg Am.</i> 1989;71(9):1343-1347.	Review/Other-Dx	N/A	To compare the sensitivity of fluoroscopically guided radiographs with that of plain radiographs in revealing lucent lines beneath the tibial component of an uncemented TKA and subsidence of the component.	Fluoroscopically guided radiographs allowed accurate measurement of a lucent line that was 1 millimeter wide. Plain radiographs were inadequate for the detection and measurement of these lucent lines, leading to inaccuracy. Fluoroscopically guided radiographs also allowed measurement of the distance between the tibial component and radiopaque markers in the proximal part of the tibial metaphysis that was reproducible to within one-half millimeter. Plain radiographs did not provide a reproducible measurement of this distance.	4
124. Hofmann AA, Wyatt RW, Daniels AU, Armstrong L, Alazraki N, Taylor A, Jr. Bone scans after total knee arthroplasty in asymptomatic patients. Cemented versus cementless. <i>Clin Orthop Relat Res.</i> 1990(251):183-188.	Observational-Dx	55 patients	To determine the natural history of bone scans after cemented and cementless TKA.	Bone scans immediately postoperative and at 3 months demonstrated increased uptake, which gradually decreased to baseline levels at 10 to 12 months. Radioisotope uptake was comparable in the cemented and cementless groups, but was highly variable in individual patients and in each of the follow-up periods.	3
125. Klett R, Steiner D, Laurich S, Bauer R, Kordelle J. Evaluation of aseptic loosening of knee prostheses by quantitative bone scintigraphy. <i>Nuklearmedizin.</i> 2008;47(4):163-166.	Observational-Dx	31 patients	To optimize the interpretation procedure and to evaluate the accuracy using results from revision surgery as standard.	To differentiate between loosened and intact prostheses we found a threshold of 5.0 for the maximum tibia to femur ratio of the both tibial regions and a threshold of 18% for the difference of the ratio of both tibial regions. Using these thresholds, values of 0.9, 1, 0.85, 1, and 0.94 were calculated for sensitivity, specificity, NPV, PPV, and accuracy, respectively. To get a sensitivity of 1, we found a lower threshold of 3.3 for the maximum tibia to femur ratio.	3
126. Archibeck MJ, Jacobs JJ, Roebuck KA, Glant TT. The basic science of periprosthetic osteolysis. <i>Instr Course Lect.</i> 2001;50:185-195.	Review/Other-Dx	N/A	To review the basic science of periprosthetic osteolysis.	Recent and ongoing work in the field of signaling pathways will continue to advance our understanding of the mechanisms of periprosthetic bone loss. Although initial animal studies are promising for the development of possible pharmacologic agents for the treatment and prevention of osteolysis, well controlled human trials are required.	4
127. Gupta SK, Chu A, Ranawat AS, Slamin J, Ranawat CS. Osteolysis after total knee arthroplasty. <i>J Arthroplasty.</i> 2007;22(6):787-799.	Review/Other-Dx	N/A	To discuss osteolysis as it relates to TKAs.	No results stated in abstract.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
128. Gonzalez MH, Mekhail AO. The failed total knee arthroplasty: evaluation and etiology. <i>J Am Acad Orthop Surg.</i> 2004;12(6):436-446.	Review/Other-Dx	N/A	To review the evaluation and etiology of failed TKAs.	No results stated in abstract.	4
129. Sneag DB, Bogner EA, Potter HG. Magnetic resonance imaging evaluation of the painful total knee arthroplasty. <i>Semin Musculoskelet Radiol.</i> 2015;19(1):40-48.	Review/Other-Dx	N/A	To review the use of MRI evaluation of the painful TKA.	MRI can reliably predict the presence and extent of infection, component loosening and polyethylene wear, and component malrotation, and it can evaluate the integrity of surrounding soft tissue structures. Using dynamic contrast-enhanced angiographic techniques, vascular pathology such as pseudoaneurysm formation and recurrent hemarthrosis can also be assessed.	4
130. Buckwalter KA, Parr JA, Choplin RH, Capello WN. Multichannel CT Imaging of Orthopedic Hardware and Implants. <i>Semin Musculoskelet Radiol.</i> 2006;10(1):86-97.	Review/Other-Dx	N/A	To discuss CT scan parameters and image postprocessing used at our institution and illustrates common clinical problems encountered when imaging implanted orthopedic devices.	No results stated in abstract.	4
131. Sofka CM, Potter HG, Adler RS, Pavlov H. Musculoskeletal imaging update: current applications of advanced imaging techniques to evaluate the early and long-term complications of patients with orthopedic implants. <i>HSS J.</i> 2006;2(1):73-77.	Review/Other-Dx	N/A	To discuss some of the current applications of CT, MRI, US, and nuclear medicine in evaluating the postoperative orthopedic patient, concentrating on the appropriate imaging evaluation for the painful arthroplasty patient.	No results stated in abstract.	4
132. Love C, Tomas MB, Marwin SE, Pugliese PV, Palestro CJ. Role of nuclear medicine in diagnosis of the infected joint replacement. <i>Radiographics.</i> 2001;21(5):1229-1238.	Experimental-Dx	N/A	To review the complications of prosthetic joint surgery and the role of radionuclide imaging in diagnosis of the infected joint replacement.	Radionuclide imaging is not affected by the presence of metallic hardware and is therefore useful for evaluating the painful prosthesis. Bone scintigraphy is useful as a screening test, despite an accuracy of only 50%-70%, because normal results essentially exclude a prosthetic complication. The addition of gallium-67, a nonspecific inflammation-imaging agent, improves the accuracy of bone scintigraphy to 70%-80%. The accuracy of combined leukocyte-marrow imaging, 90%, is the highest among available radionuclide studies. Its success is due to the fact that leukocyte imaging is most sensitive for detection of neutrophil-mediated inflammation (ie, infection).	4

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
133. Rosenthal L, Lepanto L, Raymond F. Radiophosphate uptake in asymptomatic knee arthroplasty. <i>J Nucl Med.</i> 1987;28(10):1546-1549.	Observational-Dx	30 patients with 37 knee prostheses	To determine the natural evolution of bone scans following TKR and clarify the significance of increased radiophosphate uptake in asymptomatic knee arthroplasty.	In order to better characterize the time course of radiophosphate uptake, bone scans obtained 1 mo-12 yr after surgery were analyzed in 30 asymptomatic patients with 37 TKR. Uptake was graded 0-4+ in the femoral and tibial components. Scans of 18 implants were obtained 1 yr or less after surgery (Group 1), and 19 were obtained greater than 1 yr after surgery (Group 2). Mean uptake scores were as follows: femoral component Group 1 = 3.0 +/- 1.1; Group 2 = 1.8 +/- 0.9 (p less than 0.05); tibial component Group 1 = 3.2 +/- 0.8; Group 2 = 2.6 +/- 1.1 (not significant). Persistent increased uptake, particularly in the tibial component, reflects mechanical stresses peculiar to knee prostheses, and tends to undermine confidence in diagnosing loosening on the basis of a single study.	3
134. Segura AB, Munoz A, Brulles YR, et al. What is the role of bone scintigraphy in the diagnosis of infected joint prostheses? <i>Nucl Med Commun.</i> 2004;25(5):527-532.	Observational-Dx	77 patients	To analyze the role played by bone scintigraphy in the diagnosis of infected joint prostheses.	The bone scan was positive in all patients and 28 of them had an infection (sensitivity 100%, specificity 0%). The WBC scan was positive in 61 patients but only 27 had an infection. The WBC scan was negative in 16 patients, and the possibility of infection was discarded in 15 of these cases (sensitivity 96%, specificity 30%). The results of the bone marrow scan were not compatible with those of the WBC scan (suggestive of infection) in 27 patients: 26 of them had prosthesis infection. The results of both examinations were compatible in the other 34 patients and the possibility of infection was discarded in 33 of these patients (sensitivity 92.8%, specificity 98%). The addition of a bone marrow scan to a WBC scan decreased the sensitivity from 96% to 92.8% but increased specificity from 30% to 98%. The addition of a bone scan to this dual combination did not alter the results.	2

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
135. Palestro CJ, Kim CK, Swyer AJ, Capozzi JD, Solomon RW, Goldsmith SJ. Total-hip arthroplasty: periprosthetic indium-111-labeled leukocyte activity and complementary technetium-99m-sulfur colloid imaging in suspected infection. <i>J Nucl Med.</i> 1990;31(12):1950-1955.	Observational-Dx	72 patients with 92 (68 primary, 24 revision) cemented THAs	To report the patterns of periprosthetic labeled leukocyte activity in 92 cemented total-hip arthroplasties, as well as the results of combined In-111-labeled leukocyte and Tc-99m sulfur colloid imaging of 50 of these arthroplasties.	Though present in all 23 infected arthroplasties, periprosthetic activity was also present in 77% of uninfected arthroplasties, and was greater than the contralateral zone 51% of the time. When analyzed by zone, head zone activity was the best criterion for infection (87% sensitivity, 94% specificity, 92% accuracy). 50 of the arthroplasties were studied with combined labeled leukocyte/sulfur colloid imaging. Using incongruence of images as the criterion for infection, the sensitivity, specificity, and accuracy of the study were 100%, 97%, and 98%, respectively. While variable periprosthetic activity makes labeled leukocyte imaging alone unreliable for diagnosing hip arthroplasty infection, the addition of sulfur colloid imaging results in a highly accurate diagnostic procedure.	3
136. Kandahari AM, Yang X, Laroche KA, Dighe AS, Pan D, Cui Q. A review of UHMWPE wear-induced osteolysis: the role for early detection of the immune response. <i>Bone Res.</i> 2016;4:16014.	Review/Other-Dx	N/A	To explore an immune response dominated by cells of monocytic or osteoclastogenic lineage when challenged with Ultra-high molecular weight polyethylene wear particles.	No results stated in abstract.	4
137. Benjamin J. Component alignment in total knee arthroplasty. <i>Instr Course Lect.</i> 2006;55:405-412.	Review/Other-Dx	N/A	To describe the complexities of prosthetic component positioning in TKA.	No results stated in abstract.	4
138. Moreland JR. Mechanisms of failure in total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 1988(226):49-64.	Review/Other-Dx	N/A	To describe the major mechanisms of failure in total knee arthroplasty.	No results stated in abstract.	4
139. Parratte S, Pagnano MW. Instability after total knee arthroplasty. <i>J Bone Joint Surg Am.</i> 2008;90(1):184-194.	Review/Other-Tx	N/A	To review the causes and recommended treatments of each type of instability.	No results stated in abstract.	4
140. Yercan HS, Ait Si Selmi T, Sugun TS, Neyret P. Tibiofemoral instability in primary total knee replacement: A review Part 2: diagnosis, patient evaluation, and treatment. <i>Knee.</i> 2005;12(5):336-340.	Review/Other-Dx	N/A	To cover the diagnosis, patient evaluation, and treatment of tibiofemoral instability in TKR.	No results stated in abstract.	4

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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
141. Dennis D, Komistek R, Scuderi G, et al. In vivo three-dimensional determination of kinematics for subjects with a normal knee or a unicompartmental or total knee replacement. <i>J Bone Joint Surg Am.</i> 2001;83-A Suppl 2 Pt 2:104-115.	Observational-Dx	25 patients	To determine the presence of condylar lift-off in a group of patients who had a conforming posterior stabilized total knee prosthesis, which was implanted with attention to positioning of the femoral component along the epicondylar axis.	The results of this study suggest that there is a correlation between condylar lift-off and rotational alignment of the femoral component. Reducing lift-off with a conforming articulation reduces edge-loading and in turn should reduce polyethylene damage.	4
142. Yoo JD, Kim NK. Periprosthetic fractures following total knee arthroplasty. <i>Knee Surg Relat Res.</i> 2015;27(1):1-9.	Review/Other-Dx	N/A	To review periprosthetic fractures following TKA.	Satisfactory clinical outcomes can be obtained with proper selection of fixation devices and surgical techniques. Accurate diagnosis and appropriate intervention are of utmost importance in the treatment of periprosthetic fractures.	4
143. Cross MB, Nam D, van der Meulen MC, Bostrom MP. A rare case of a bisphosphonate-induced peri-prosthetic femoral fracture. <i>J Bone Joint Surg Br.</i> 2012;94(7):994-997.	Review/Other-Dx	1 case	To review a rare case of bisphosphonate-induced peri-prosthetic femoral fracture.	While the current definition of an atypical fracture of the femur excludes peri-prosthetic fractures, this case suggests that they do occur and should be considered in patients with severe osteopenia. Union of the fracture followed cessation of bisphosphonates and treatment with teriparatide. Thus, this case calls into question whether prophylactic intramedullary nailing is sufficient alone to treat early or completed atypical femoral fractures.	4
144. Nam D, Abdel MP, Cross MB, et al. The management of extensor mechanism complications in total knee arthroplasty. AAOS exhibit selection. <i>J Bone Joint Surg Am.</i> 2014;96(6):e47.	Review/Other-Dx	N/A	To (1) review the relevant anatomy of the knee extensor mechanism, (2) present risk factors that may lead to extensor mechanism complications, (3) provide a diagnostic and treatment algorithm for each of the aforementioned problems, and (4) review the specific surgical techniques of Achilles tendon allograft reconstruction and synthetic mesh augmentation.	Extensor mechanism disorders following TKA remain difficult to manage effectively. Although various surgical techniques have been used, the results in patients with a prior TKA are inferior to the results in the young adult without such a prior procedure. Surgical attempts at restoration of the knee extensor mechanism are usually warranted; however, the outcomes of treatment of these complications are often poor, and management of patient expectations is important.	4

**Imaging After Total Knee Arthroplasty
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Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
145. Keating EM, Haas G, Meding JB. Patella fracture after post total knee replacements. <i>Clin Orthop Relat Res.</i> 2003(416):93-97.	Review/Other-Tx	4,583 TKRs in 3,054 patients	To determine the incidence, clinical function, and complications of treatment in a large series of patella fractures after TKR.	177 fractures were identified in 135 patients for a fracture incidence of 3.8%. 22 fractures were vertical and had a stable implant and intact extension mechanism (Type 1). 21 fractures had disruption of the extensor mechanism of <1 cm (Type 2A). 17 fractures had disruption of the extensor mechanism of 1 cm or more (Type 2B). 114 fractures had a loose component and an intact extension mechanism (Type 3). Patients treated nonoperatively generally had no extensor lag and had adequate pain and function scores. Patients treated operatively had a high complication rate. 4 of 9 patients treated with excision of an extruded patella button developed a deep infection. Both patients treated with open reduction internal fixation had a nonunion develop. Surgery on patients with patella fractures has a high complication rate and should be avoided if possible.	4
146. Chun KA, Ohashi K, Bennett DL, El-Khoury GY. Patellar fractures after total knee replacement. <i>AJR Am J Roentgenol.</i> 2005;185(3):655-660.	Review/Other-Tx	17 cases	To describe the patterns of patellar fracture after TKR and assess their clinical significance.	The incidence of patellar fractures after TKR was 1.14%. The mean time from TKR to patellar fracture was 17.5 months. 9 fractures were asymptomatic and identified on routine follow-up radiographs. The patterns of fracture were diverse: Transverse (n = 6), comminuted (n = 2), vertical (n = 5), and avulsion (n = 4) fractures were seen. 13 fractures were displaced. Patellar osteonecrosis was suspected in 4 fractures, and 3 fractures were associated with disruption of the quadriceps tendons. 13 fractures were treated nonoperatively, and 4 were treated surgically.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
147. Meding JB, Fish MD, Berend ME, Ritter MA, Keating EM. Predicting patellar failure after total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 2008;466(11):2769-2774.	Observational-Tx	5,640 patients with 8,531 TKAs	To assess the factors and relative risks associated with patellar failure after TKA.	Follow-up averaged 7.0 years (range, 2-22 years). Patellar component loosening occurred in 4.8% of TKAs (409 knees). Patellar fracture was identified in 5.2% of TKA (444 knees). 25 patellae were revised (0.3%). TKA performed with a lateral release and patients with a body mass index of >30 kg/m ² were at the greatest risk of patellar loosening and fracture, respectively. Male gender, preoperative varus alignment of greater than 5 degrees, and large patellar component size also predicted a higher risk of patellar fracture. Medial patellar component position, tibial component thickness of >12 mm, preoperative valgus alignment of 10 degrees or more, and preoperative flexion of 100 degrees or more predicted patellar loosening. An awareness of these factors that predict patellar failure after TKA may help determine the relative indications for TKA and influence surgical technique, especially when using this prosthesis.	2
148. Melloni P, Valls R, Veintemillas M. Imaging patellar complications after knee arthroplasty. <i>Eur J Radiol.</i> 2008;65(3):478-482.	Review/Other-Tx	1,272 patients	To describe complications affecting the patella in patients with total or partial knee arthroplasty.	The mean interval from knee replacement to patellar complications was 5 years and 7 months (range, 5 months to 14 years). The complications described include fracture, instability, dislocation or luxation, necrosis of the patella, infection of the patella, erosion of the patella, patellar impingement on the prosthesis and patellar or quadriceps tendon tear. We discuss the pathological imaging findings in the patella and their differential diagnosis after knee arthroplasty.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
149. Bayley JC, Scott RD, Ewald FC, Holmes GB, Jr. Failure of the metal-backed patellar component after total knee replacement. <i>J Bone Joint Surg Am.</i> 1988;70(5):668-674.	Review/Other-Tx	25 patients	To explore the variables that may have contributed directly to failure of the patellar component in a series of 25 patients.	25 patients had failure of a metal-backed patellar component after TKR. 5 manufacturers and 7 designs were involved. There was no apparent correlation between failure of the component and the age or sex of the patient, the diagnosis, the use of cement, the femorotibial alignment, or the use of lateral release. The patients in whom the patellar implant failed were relatively heavy, and the diagnosis in most of them was osteoarthritis. The failure was due to 1 of 2 mechanisms: wear or fracture, or both, of the polyethylene over the edge of the metal backing (18 components), or dissociation of the polyethylene or the base-plate, or both, from the anchoring pegs (7 components). In many of the patients, failure of the component was not suspected before arthrotomy. The failure led to considerable wear of the femoral component in 11 patients and to metal-induced synovitis in 23. We concluded that metal backing may predispose the patellar component to a small but important likelihood of failure, and we urge caution in choosing a metal-backed patellar implant.	4
150. Kelly MA. Patellofemoral complications following total knee arthroplasty. <i>Instr Course Lect.</i> 2001;50:403-407.	Review/Other-Dx	N/A	To review patellofemoral complications following TKA.	The diagnosis and treatment of the more frequent complications of the extensor mechanism following TKA have been discussed. Although these complications may be successfully treated, most may be largely avoided with proper surgical technique and prosthetic component design.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
151. Piraino D, Richmond B, Freed H, Belhobek G, Schils J, Stulberg B. Total knee replacement: radiologic findings in failure of porous-coated metal-backed patellar component. <i>AJR Am J Roentgenol.</i> 1990;155(3):555-558.	Review/Other-Dx	10 cases	To determine if any specific radiologic findings are seen before component failure or at the time of failure.	7 cases of failure involved the patellar pegs or junction of the pegs with the metal backing and 3 cases involved the polyethylene portion. In the 7 cases of peg-metal backing failure, 3 cases showed loose beads before failure and 7 cases showed displacement of the metal backing at time of failure. All 3 cases of polyethylene failure showed narrowing or displacement of the polyethylene portion. Our experience shows that displacement of the metal backing, displacement of the polyethylene, and disruption of patellar pegs are seen in failed porous-coated metal-backed patellar components. Loose beads may be seen before peg-metal backing failure.	4
152. Meneghini RM. Should the patella be resurfaced in primary total knee arthroplasty? An evidence-based analysis. <i>J Arthroplasty.</i> 2008;23(7 Suppl):11-14.	Review/Other-Tx	N/A	To discuss the available literature on patellar resurfacing through an evidence-based analysis.	No results stated in abstract.	4
153. Eisenhuth SA, Saleh KJ, Cui Q, Clark CR, Brown TE. Patellofemoral instability after total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 2006;446:149-160.	Review/Other-Dx	N/A	To review patellofemoral instability after TKA.	A thorough understanding of the etiologies of patellofemoral instability, careful preoperative planning and meticulous surgical techniques will optimize clinical outcome. Evaluation of patellofemoral stability should begin in the operating room. Postoperatively, thorough history, physical examination, and dedicated radiographic studies should be obtained. CT scan is the most accurate and reliable way to assess component positioning. Treatment of patellofemoral instability is directed by its etiology. Revision of 1 or both components is indicated if malpositioning is present. If the components are determined to be in satisfactory positions, soft tissue procedures can be pursued. Future advancements in prosthetic design and the routine use of computer-assisted navigation systems will minimize patellofemoral instability.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
154. Berger RA, Crossett LS, Jacobs JJ, Rubash HE. Malrotation causing patellofemoral complications after total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 1998(356):144-153.	Observational-Dx	50 patients	To compare patients with isolated patellofemoral complications after TKA with patients with well-functioning knee replacements with patellofemoral complications.	The group with patellofemoral complications had excessive combined (tibial plus femoral) internal component rotation. This excessive combined internal rotation was directly proportional to the severity of the patellofemoral complication. Small amounts of combined internal rotation (1 degree-4 degrees) correlated with lateral tracking and patellar tilting. Moderate combined internal rotation (3 degrees-8 degrees) correlated with patellar subluxation. Large amounts of combined internal rotational (7 degrees-17 degrees) correlated with early patellar dislocation or late patellar prosthesis failure. The control group was in combined external rotation (10 degrees-0 degree).	3
155. Parvizi J, Kim KI, Oliashirazi A, Ong A, Sharkey PF. Periprosthetic patellar fractures. <i>Clin Orthop Relat Res.</i> 2006;446:161-166.	Review/Other-Tx	12 patients	To present the results of peri-prosthetic patellar fractures in 12 patients.	11 type I nondisplaced fractures (7 cases) were treated nonoperatively. Surgical treatment was selected for the remaining 5 cases which included resection arthroplasty combined with open reduction and internal fixation of the fracture (3 knees), partial patellectomy (1 knee), and total patellectomy (1 knee). The outcome was excellent in 1 knee, good in 8 knees, and fair in the remaining 3 knees at the latest follow-up. There were 2 reoperations; 1 for disruption of the extensor mechanism and 1 for refracture. 1 patient developed a superficial wound infection.	4
156. Baldini A, Anderson JA, Zampetti P, Pavlov H, Sculco TP. A new patellofemoral scoring system for total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 2006;452:150-154.	Observational-Dx	69 patients; 100 knees	To report a new scoring system and weightbearing view that are easy to use and more accurately represent patellofemoral kinematics than do conventional methods of analysis.	Preoperative Knee Society knee and function scores were 43 +/- 5 points, and 39 +/- 15 points, respectively. Postoperatively, scores increased to 93 +/- 8 and 89 +/- 8 points, respectively. The patella score averaged 89 +/- 8 points and showed satisfactory interobserver variability.	3
157. Berger RA, Rubash HE. Rotational instability and malrotation after total knee arthroplasty. <i>Orthop Clin North Am.</i> 2001;32(4):639-647, ix.	Review/Other-Dx	N/A	To review rotational instability and malrotation after TKA.	No results stated in abstract.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
158. Kanekasu K, Kondo M, Kadoya Y. Axial radiography of the distal femur to assess rotational alignment in total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 2005(434):193-197.	Observational-Dx	50 knees in 32 patients	To evaluate if a modified radiography would result in comparable reproducibility and correlate will with results from CT images.	The interobserver variation in the axial radiography was less than or comparable to the CT method. The mean discrepancy between the 2 methods (+/- standard deviation) was 0.5 degrees +/- 0.4 degrees (range, 0-1.9 degrees), and a strong correlation was observed. This plain radiography is acceptable for evaluation of femoral component rotation with comparable reproducibility and correlation to the results with CT. It has several advantages regarding cost, radiation dose, and lack of scatter when used for postoperative assessment.	3
159. Whiteside LA, Arima J. The anteroposterior axis for femoral rotational alignment in valgus total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 1995(321):168-172.	Observational-Tx	46 TKS using posterior femoral condyles; 107 TKAs using anteroposterior axis	To evaluate a technique using the anteroposterior axis of the distal femur, rather than the transepicondylar or posterior femoral condylar axis, to establish rotational alignment of the femoral component in valgus knees.	In the group of knees using the posterior condylar axis, medial tibial tubercle transfer was needed intra-operatively in 8 knees to prevent lateral dislocation of the patella. In the first 2 postoperative years, 4 knees had recurrent patellar dislocation or subluxation that required surgical correction. In the group of knees using the anteroposterior axis, patellar tracking problems that required realignment were significantly reduced. 1 knee required medial tibial tubercle transfer to correct a Q angle >20 degrees. In the remaining knees, the Q angle was <10 degrees, and patellar tracking was acceptable. 2 years after surgery, no knees had patellar instability.	2
160. Roper GE, Bloemke AD, Roberts CC, Spangehl MJ, Clarke HD. Analysis of tibial component rotation following total knee arthroplasty using 3D high definition computed tomography. <i>J Arthroplasty.</i> 2013;28(8 Suppl):106-111.	Observational-Dx	60 knees	To define a technique for measuring tibial rotation using this single CT image; 2) to validate the intra-observer and inter-observer reliability of this measurement technique (It is important to emphasize that we were not attempting to define an acceptable range for tibial rotation, simply to provide a tool to accurately and reproducibly make these measurements that could be used in future studies); and 3) to compare the intra-observer and inter-observer reliability of the measurement technique for tibial components made of different materials.	The intra-reliability and inter-reliability both exceeded 0.9 whether the tibial component was made of titanium, cobalt-chrome or all-polyethylene.	2

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
161. Griffin FM, Math K, Scuderi GR, Insall JN, Poilvache PL. Anatomy of the epicondyles of the distal femur: MRI analysis of normal knees. <i>J Arthroplasty</i> . 2000;15(3):354-359.	Review/Other-Dx	104 knee MRIs	To define useful landmarks and relationships using MRI studies.	The epicondyles are described, and the relationship of the epicondyles to the joint line is defined in multiple planes. Some significant gender differences were noted. The distance from the epicondyles to the joint line correlates with the transepicondylar width of the distal femur. This information can be helpful in determining appropriate joint line position intraoperatively. The posterior condylar angle averaged 3.11 degrees for all patients, and a tendency for the posterior condylar angle to increase with age was noted, but further study of this tendency is needed.	4
162. Murakami AM, Hash TW, Hepinstall MS, Lyman S, Nestor BJ, Potter HG. MRI evaluation of rotational alignment and synovitis in patients with pain after total knee replacement. <i>J Bone Joint Surg Br</i> . 2012;94(9):1209-1215.	Observational-Dx	50 patients with TKRs and 16 controls	To determine the feasibility of using MRI in evaluating the rotational alignment of the components.	Between 2 observers, there was very high interobserver agreement in the measurements of all values. Patients with painful TKRs demonstrated statistically significant relative internal rotation of the femoral component ($P=0.030$). There was relative internal rotation of the tibial to femoral component and combined excessive internal rotation of the components in symptomatic knees, although these results were significant only with 1 of the observers ($P=0.031$). There was a statistically significant association between the presence and severity of synovitis and painful TKR ($P<0.001$).	3
163. Schoderbek RJ, Jr., Brown TE, Mulhall KJ, et al. Extensor mechanism disruption after total knee arthroplasty. <i>Clin Orthop Relat Res</i> . 2006;446:176-185.	Observational-Tx	290 patients	To identify all relevant literature pertaining to extensor mechanism disruptions associated with TKA focusing on different treatment options and relevant postoperative outcomes. The second objective was to ascertain through a prospective study, the functional outcomes of extensor mechanism reconstructions using validated health related quality of life measures with a hypothesis that patients who disrupt their extensor mechanism have lower functional outcomes after TKA revision.	6 out of 290 patients in the study had extensor mechanism disruption and this group of patients had overall worse functional outcomes. The results of the study have solidified our knowledge that patients with extensor mechanism disruptions have worse functional outcomes and will need intensive management and rehabilitation.	2
164. Allen AM, Ward WG, Pope TL, Jr. Imaging of the total knee arthroplasty. <i>Radiol Clin North Am</i> . 1995;33(2):289-303.	Review/Other-Dx	N/A	To review the essentials of TKA imaging.	Because the purpose of a knee arthroplasty is to relieve pain and improve function, radiographs should be viewed in the context of these goals.	4

**Imaging After Total Knee Arthroplasty
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
165. Sofka CM, Potter HG, Figgie M, Laskin R. Magnetic resonance imaging of total knee arthroplasty. <i>Clin Orthop Relat Res.</i> 2003;406):129-135.	Review/Other-Dx	41 patients; 46 knees	To review their experience with MRI of TKA, evaluate the conspicuity of the periprosthetic soft tissue and osseous components, and correlate findings with their influence on clinical treatment.	41 patients (46 knees) had MRI, tailored to reduce metallic susceptibility artifact, after TKA, and the findings and clinical and surgical follow-up were reviewed. All studies consistently showed the integrity of the periprosthetic soft tissues. MRI findings led to surgical or other therapeutic interventional procedures in 20 patients, and influenced clinical treatment in all patients.	4
166. Kenan S, Kahn L, Haramati N. A rare case of pseudotumor formation associated with methyl methacrylate hypersensitivity in a patient following cemented total knee arthroplasty. <i>Skeletal Radiol.</i> 2016;45(8):1115-1122.	Review/Other-Dx	1 patient	To discuss a case report of a 68-year-old female who, after undergoing a routine cemented right TKA, developed a painless, enlarging mass during a 13-year period.	This mass was found to be a pseudotumor in association with methyl methacrylate hypersensitivity	4
167. Boldt JG, Munzinger UK, Zanetti M, Hodler J. Arthrofibrosis associated with total knee arthroplasty: gray-scale and power Doppler sonographic findings. <i>AJR Am J Roentgenol.</i> 2004;182(2):337-340.	Observational-Dx	38 cases with arthrofibrosis and 38 controls	To determine gray-scale and power Doppler US findings in patients with arthrofibrosis associated with TKA.	Synovial membrane thickness was significantly ($P<0.001$) increased in the arthrofibrosis group (medial, 3.4 mm; lateral, 3.0 mm; suprapatellar, 3.1 mm) when compared with the control group (medial, 2.0 mm; lateral, 2.0 mm; suprapatellar, 1.9 mm). When a cutoff of 3.0 mm was used, US had a sensitivity of 84% and a specificity of 82% for detecting arthrofibrosis. Neovascularity (rated as grades 0-3) of the synovial membrane and Hoffa's fat pad was significantly ($P\leq 0.003$) more pronounced in the arthrofibrosis group (medial, 1.1; lateral, 1.2; suprapatellar, 1.0; Hoffa's fat pad, 1.1) than in the control group (medial, 0.1; lateral, 0.3; suprapatellar, 0.2; Hoffa's fat pad, 0.1). No significant difference was seen between study groups with regard to the amount of joint effusion at 3 locations and with regard to patellar tendon thickness.	3
168. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: http://www.acr.org/~media/ACR/Documents/AppCriteria/RadiationDoseAssessmentIntro.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document on exposure of patients to ionizing radiation.	N/A	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

CI = Confidence interval

CRP = C-reactive protein

CT = Computed tomography

ESR = Erythrocyte sedimentation rate

FDG-PET = Fluorine-18-2-fluoro-2-deoxy-D-glucose-positron emission tomography

HMPAO = Hexamethylpropyleneamine oxime

IQR = Interquartile range

MRI = Magnetic resonance imaging

NPV = Negative predictive value

PJI = Prosthetic joint infection

PPV = Positive predictive value

ROC = Receiver-operator characteristic

SEMAC = Slice-encoding for metal artifact correction

SPECT = Single photon emission computed tomography

STIR = Short tau inversion recovery

THA = Total hip arthroplasty

TKA = Total knee arthroplasty

TKR = Total knee replacement

US = Ultrasound

WBC = White blood cell