Hi, this is Dr. Jeff Klein, editor of RadioGraphics and welcome to the RadioGraphics audio summary podcast. Each issue, I will be highlighting a few of our articles that I think are important.

Deep Learning Electronic Cleansing for Single- and Dual-Energy CT Colonography
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In this Informatics paper in the current issue of RadioGraphics, radiologists and physicists from the U.S., Japan, Korea, and Italy review the post-processing method of electronic cleansing for removing tagged fecal material to improve the visibility of polyps on CT colonography. These deep learning electronically-cleansed techniques are particularly useful with current non-cathartic bowel prep CT colonographic scans performed using low-dose acquisition techniques. The authors begin their review by describing conventional electronic cleansing used in conjunction with rigorous cathartic bowel preparation, which is associated with three particular cleansing artifacts that appear similar to or distort polyps on CT colonography. A Type I (or air-tagged boundary) artifact, illustrated in Figure 1, is a residual soft-tissue layer at the interface between tagged material and air that obscures the bowel wall. Type II (three material boundary) artifacts are seen when tagged fecal material is situated next to a thin fold, and electronic cleansing incorrectly removes the fold. Type III artifacts, known as three material mixture artifacts, are partial volume mixtures of air, soft tissue, and tagged material that result in pseudopolyps or artificial diverticula on electronic cleansing. The authors then detail their development and use of deep convolutional neural networks using single and dual-energy CT acquisitions to generate electronically-cleansed volumetric virtual CT colonographic images. The paper illustrates the reduction in Type I, II, and III artifacts by comparing original uncleansed images, conventional electronically-cleansed images, and deep-learning single-energy and dual-energy electronically-cleansed images. Figures 11 through 13 illustrate how the use of electronic cleansing using deep learning virtual monochromatic images derived from dual energy acquisitions can be used to eliminate artifacts in patients with a polyp submerged in tagged fluid, with tagged fluid adjacent to a polyp, and with a polyp submerged in semisolid fecal material. The main limitations of the deep learning electronic technique are the same as for many applications of these techniques; that it requires a large number of annotated samples for appropriate training, that it cannot interpret situations that it has not been trained to detect, and that it remains unknown exactly what the neural network has actually detected. This latter limitation would make it difficult to understand why the neural network has not performed well when encountering new unseen cases.

Imaging Features and Management of Stress, Atypical, and Pathologic Fractures
Richard A. Marshall, MD • Jacob C. Mandell, MD • Michael J. Weaver, MD • Marco Ferrone, MD • Aaron Sodickson, MD, PhD • Bharti Khurana, MD

In their paper on atraumatic fractures, Dr. Richard Marshall and colleagues from the Department of Radiology and Orthopedics at the Brigham and Women’s Hospital detail the terminology, pathophysiology, imaging features, and management of stress fractures, atypical femoral fractures, and pathologic fractures. Beginning with a review of terminology, stress fractures are subdivided into fatigue and insufficiency fractures. Atypical femoral fractures are transverse fractures seen in the lateral femoral diaphysis resulting from deficiencies in normal bone turnover and the remodeling pathway. Pathologic fractures are considered to occur through focal neoplasms. Following a review of bone structure and the pathophysiology of fractures, the paper delves into stress fractures and reviews radiographic and MR features of these fractures, emphasizing the near 100% sensitivity of MR in this setting. Imaging, particularly MR, plays an important role in stratifying stress fractures into low and high risk, thereby guiding management, with MR findings using the Fredericson classification system useful in guiding return-to-play decisions for athletes. Atypical femoral fractures are insufficiency fractures that are most often seen in patients receiving long-term medication such as bisphosphonate therapy that impedes osteoclast-mediated normal bone turnover. Characteristic localized periosteal or endosteal thickening is seen in the lateral femoral diaphyseal cortex, and there may be a characteristic spiking of the medial aspect of the outer cortex. Patients with atypical femoral fractures should be screened with radiography or MR for contralateral femoral involvement as up to 44% of patients will have synchronous or subsequent fractures contralaterally. Pathologic fractures are usually readily distinguished from stress fractures, but this distinction can be difficult when there is irregular periosteal reaction or exuberant osteolysis; the authors provide clinical, imaging, and location clues to help make the correct diagnosis. MRI, owing to its ability to detect marrow signal intensity abnormalities, is best suited to distinguishing non-pathologic from pathologic fractures. This is particularly important in the spine, as osteoporotic compression (i.e. insufficiency) fractures...
can be difficult to distinguish from pathologic fractures; the authors review those features on MR imaging that help in this regard. In the final portion of the paper, the authors review the role of the radiologist in estimating pathologic fracture risk in the appendicular skeleton using Mirels criteria, which helps the radiologist guide the orthopedic surgeon to providing appropriate management of these lesions and this is summarized in table format.

Layered Approach to the Anterior Knee: Normal Anatomy and Disorders Associated with Anterior Knee Pain
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Anterior knee pain is a common clinical complaint that can be caused by a variety of disorders. In their musculoskeletal radiology paper in the current issue, Dr. Dyan Flores from the Philippines Orthopedic Center in Metro Manila, Philippines and colleagues in Columbia and San Diego, California review the four layers of the anterior knee to be evaluated that are summarized in Table 1. After a brief review of imaging modalities used for assessing anterior knee disease with a focus on spin echo and STIR MR sequences, the authors peel away the mystery surrounding this subject beginning with Layer 1, which is comprised of the superficial soft tissues. The most common condition affecting Layer 1 is symptomatic bursitis of the superficial prepatellar and infrapatellar bursae; Figures 3 and 4 are illustrative examples as seen on MRI. The prepatellar region is the second most common location after the hip and buttocks for a Morel-Lavallée lesion resulting from a degloving injury. Layer 2 reflects the extensor mechanism of the knee and includes the quadriceps tendon, patella, patellar tendon, and tibial tuberosity. The normal anatomy and pathology of the quadriceps tendon, patellar conditions including Sinding Larsen Johansson syndrome, fractures and neoplasms are all highlighted. The patellar tendon is easily assessed on imaging, typically using axial and lateral radiography, as are summarized in Table 2. Layer 3 includes the intracapsular extrasynovial fat pads of the knee that can be the source of anterior knee pain: these include the infrapatellar (Hoffia) fat pad, the posterior suprapatellar or prefemoral fat pad, and the anterior suprapatellar or quadriceps fat pad. Layer 4 includes intra-articular disorders such as plica syndromes, arthritis (in particular patellofemoral arthritis, inflammatory arthritis due to infection, rheumatoid arthritis or seronegative arthritis), lipoma arborescens, calcium pyrophosphate dihydrate deposition disease, and gout. Intra-articular neoplasms including pigmented villonodular synovitis, focal nodular synovitis, and synovial chondromatosis can all affect the knee, with characteristic imaging findings.

LI-RADS Version 2018 Ancillary Features at MRI
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This article in a series of papers from the American College of Radiology’s LI-RADS group focuses on CT/MR LI-RADS version 2018 ancillary features, which can be applied following assessment using major imaging features to improve detection and characterization of lesions, increase diagnostic confidence level, or adjust LI-RADS categories. Following a brief review of LI-RADS categories summarized in Figure 1, the paper details the ancillary features to be considered, which are divided into those favoring malignancy in general, those favoring hepatocellular carcinoma in particular, and those favoring benignity, which can all be found listed in Table 1. The rules for the application of ancillary features is diagrammed in Figure 2; briefly these features can be used to upgrade or downgrade the lesion by one grade but cannot be used to upgrade from LR-4 (probable HCC) to LR-5 (definite HCC). Those ancillary features that favor malignancy in general and the diagnostic performance of ancillary features favoring malignancy in general are summarized in Tables 2 and 3 in the paper; Table 2 also details the utility of MR performed with extracellular and hepatobiliary contrast agents in characterizing each individual feature. Each of these nine ancillary features is then individually reviewed, the rationale for its use discussed, and diagnostic performance reviewed, with illustrative examples provided for each. The list of ancillary imaging features that favor hepatocellular carcinoma in particular is shorter, with these five features listed in Table 4; extracellular and hepatobiliary contrast agents can be used to help characterize all five of these features on MRI. The third and final major section of this review describes the six ancillary features favoring benignity, with a summary of those three features, namely parallels blood pool enhancement, marked T2 hyperintensity, and hepatobiliary phase isointensity, for which diagnostic accuracy results have been published. The paper concludes with two detailed case examples that illustrate the effect of ancillary features including conflicting ancillary features on LI-RADS categorization.
The modern diagnosis, prognosis, and treatment of pediatric brain tumors relies on genetic profiling along with traditional histopathologic features of disease. Imaging is an important contributor not only in detection but in offering a brief differential diagnosis and where possible a specific subtype of tumor and its associated prognosis. In this extensive review of pediatric brain tumors from the group at the Hospital for Sick Children in Toronto, Ontario, Canada, Dr. Alrahayi and colleagues review the concept of radiomics or the relationship between imaging characteristics and genomic features of these tumors. Following a brief schematic representation of the biologic features of tumorigenesis, the paper begins with a discussion of low-grade gliomas, which in pediatric patients are usually associated with a single BRAF mutation in the MAPK pathway. Following a review of the imaging of low-grade gliomas, the authors review high-grade gliomas which are associated with a much broader and more complex spectrum of genomic alterations, which are reviewed in detail and illustrated in Figure 5. For medulloblastomas, the most common malignant posterior fossa tumor, there are four molecular subgroups with distinct clinical, radiologic, and prognostic features, which are summarized in Table 3. The three imaging phenotypes of medulloblastoma that include 1) anatomic location, 2) enhancement pattern, and 3) metastasis can predict the molecular subtype of disease and therefore the prognosis. Ependymomas are the final pediatric brain tumor reviewed. The paper reviews the molecular subgroups of supratentorial and infratentorial ependymomas, and provides examples of these tumors that most often arise in the posterior fossa.

In the evaluation of patients with early-age onset of mild cognitive impairment or in those with atypical clinical features, amyloid PET can be a valuable tool in determining a diagnosis of Alzheimer dementia. This paper from Dr. Tamara Lundeen at the University of Arizona and colleagues in New Haven, Connecticut and St. Louis, Missouri reviews the background behind the use of 18F-labeled amyloid-binding pharmaceuticals that cross the blood brain barrier and detect amyloid deposits in the brain that are a hallmark of Alzheimer dementia. Given that cerebral amyloid deposits can be seen in patients without cognitive impairment, amyloid PET must be used in an appropriate clinical setting in conjunction with evaluation by a dementia expert; the Alzheimer’s Association Amyloid Imaging Task Force and the Society of Nuclear Medicine has set forth appropriate use criteria for amyloid imaging that are reviewed in the paper. The three FDA-approved 18F-labeled amyloid PET agents are florbetapir, flutemetamol, and florbetaben. A summary of the dose, acquisition time, image display, and number of regions required for a positive scan are shown in table format, with representative amyloid negative and amyloid positive images for each agent provided as a reference. The paper offers an extensive atlas of imaging signs for each involved region, beginning with the temporal-occipital region by demonstrating the “kissing hemispheres” sign at florbetapir PET. In the frontal region one can see the “cartoon hand” and “tree-in-winter” signs in the amyloid-negative brain and tree-in summer sign in amyloid positive brain at florbetapir PET. On florbetaben amyloid PET of the parietal region in an amyloid negative brain, the “double convex lens” sign can be seen on axial imaging. Flutemetamol amyloid PET can show uptake in the striatal regions that on positive scans bridges the gap between the frontal and thalamic white matter producing the “striatal bridge” sign. Figure 12 summarizes these regional findings on amyloid PET imaging. The final section reviews imaging pitfalls and artifacts, with cortical atrophy the most common pitfall producing a false negative PET study in an amyloid-positive patient.

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