

AMSER Case of the Month

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41-year-old female with right knee pain

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Patient Presentation

HPI: 41-year-old female presents with right knee pain after a recent twisting injury. She was painting on a window ledge when she felt a pop in her knee upon stepping down, after which she had the sensation of her knee giving out when she attempted to walk. She denies pain in any other joints or other injuries during this episode. Now, her pain is localized to the lateral aspect of the right knee and limits ambulation; it is relieved by keeping the right leg still.

Patient Presentation (Continued)

- Past Medical History: None
- Past Surgical History: vaginal delivery, cesarean section, colposcopy
- Social history: social alcohol use, denies tobacco or illicit drug use
- Daily Medications: ibuprofen PRN for pain
- Vitals: Stable, unremarkable
- Pertinent Labs: None

Physical Exam

General: Awake, alert, oriented

Right Lower Extremity:

Moderate knee effusion

Tenderness to palpation over the lateral aspect of the knee

Skin intact

Ligamentous testing negative on varus/valgus stress (limited by guarding)

Strength 5/5 on ehl/fhl/df/pf

Sensation intact to light touch over dp/sp/t/su/sa distributions

Pulse 2+ over dp

What Imaging Should We Order?

Select the applicable ACR Appropriateness Criteria

Variant 2:

Adult or child 5 years of age or older. Fall or acute twisting trauma to the knee. One or more of the following: focal tenderness, effusion, inability to bear weight. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography knee	Usually Appropriate	⊕
Bone scan with SPECT or SPECT/CT knee	Usually Not Appropriate	⊕⊕⊕
CT knee with IV contrast	Usually Not Appropriate	⊕
CT knee without and with IV contrast	Usually Not Appropriate	⊕
CT knee without IV contrast	Usually Not Appropriate	⊕
MR arthrography knee	Usually Not Appropriate	○
MRA knee without and with IV contrast	Usually Not Appropriate	○
MRA knee without IV contrast	Usually Not Appropriate	○
MRI knee without and with IV contrast	Usually Not Appropriate	○
MRI knee without IV contrast	Usually Not Appropriate	○
US knee	Usually Not Appropriate	○

Ordered by Attending Physician in the ED

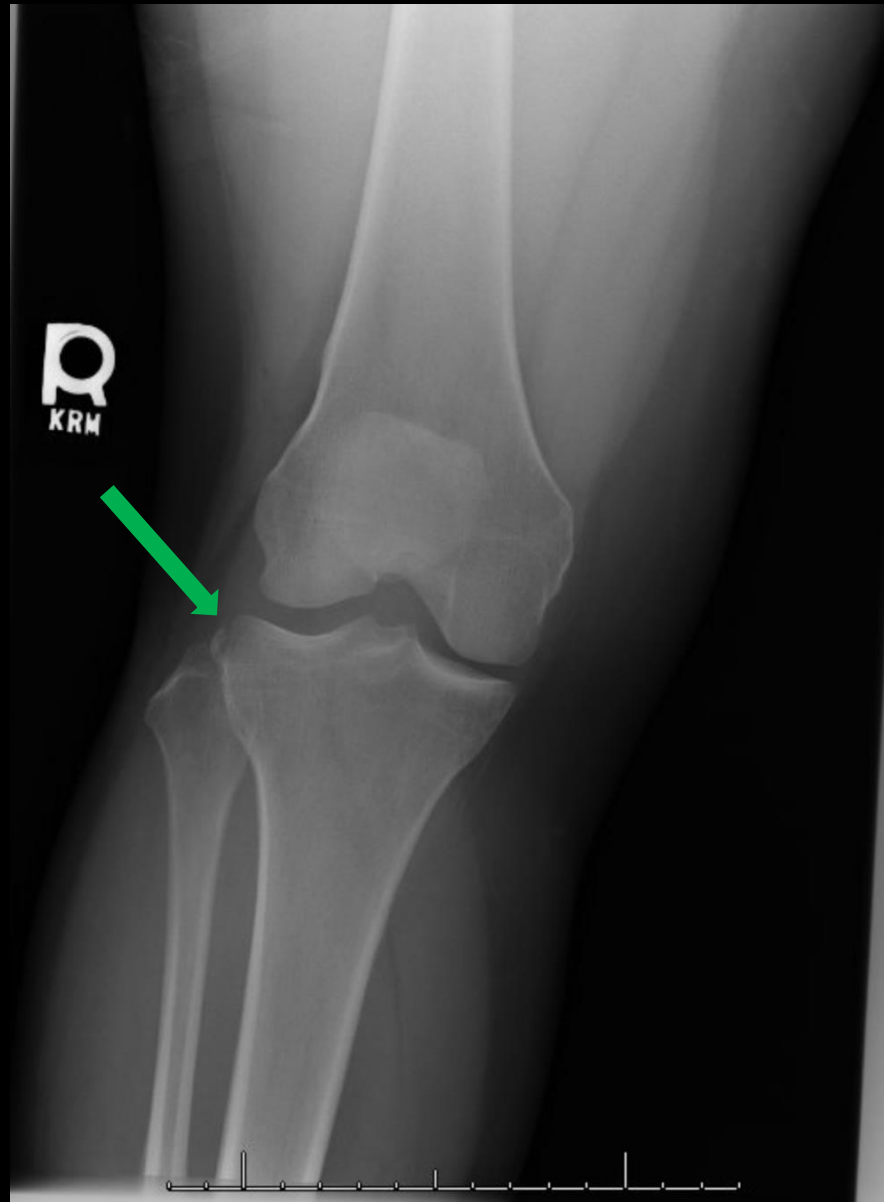


Findings (unlabeled)



Right Knee lateral
(left) and AP (right)

Findings (labeled)



extra-articular,
minimally displaced
fracture of the
lateral tibial plateau
(green)

suprapatellar joint
effusion (orange)

What Imaging Should We Order Next?

Select the applicable ACR Appropriateness Criteria

Variant 5:

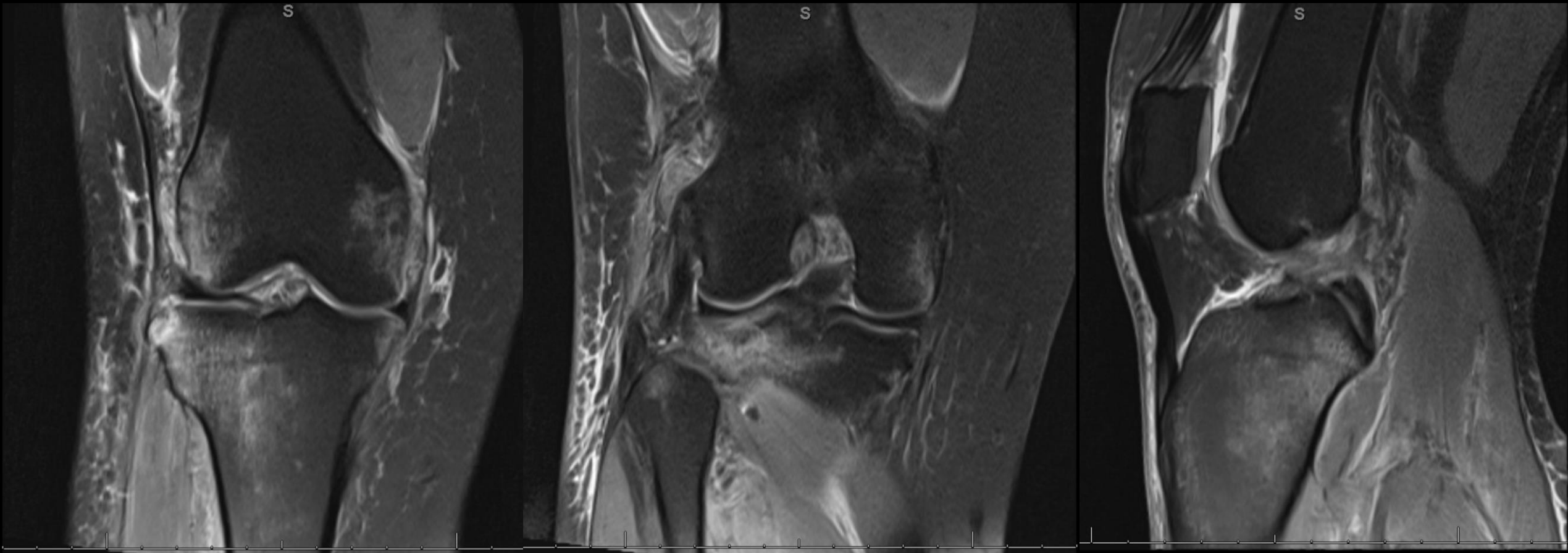
Adult or child 5 years of age or older. Fall or acute twisting trauma to the knee. Tibial plateau fracture on radiographs. Suspect additional bone or soft-tissue injury. Next study.

	Appropriateness Category	Relative Radiation Level
MRI knee without IV contrast	Usually Appropriate	○
CT knee without IV contrast	Usually Appropriate	⊕
Bone scan with SPECT or SPECT/CT knee	Usually Not Appropriate	⊕⊕⊕
CT knee with IV contrast	Usually Not Appropriate	⊕
CT knee without and with IV contrast	Usually Not Appropriate	⊕
MR arthrography knee	Usually Not Appropriate	○
MRA knee without and with IV contrast	Usually Not Appropriate	○
MRA knee without IV contrast	Usually Not Appropriate	○
MRI knee without and with IV contrast	Usually Not Appropriate	○
US knee	Usually Not Appropriate	○

Ordered by Attending Physician at Orthopedic Clinic Follow-up

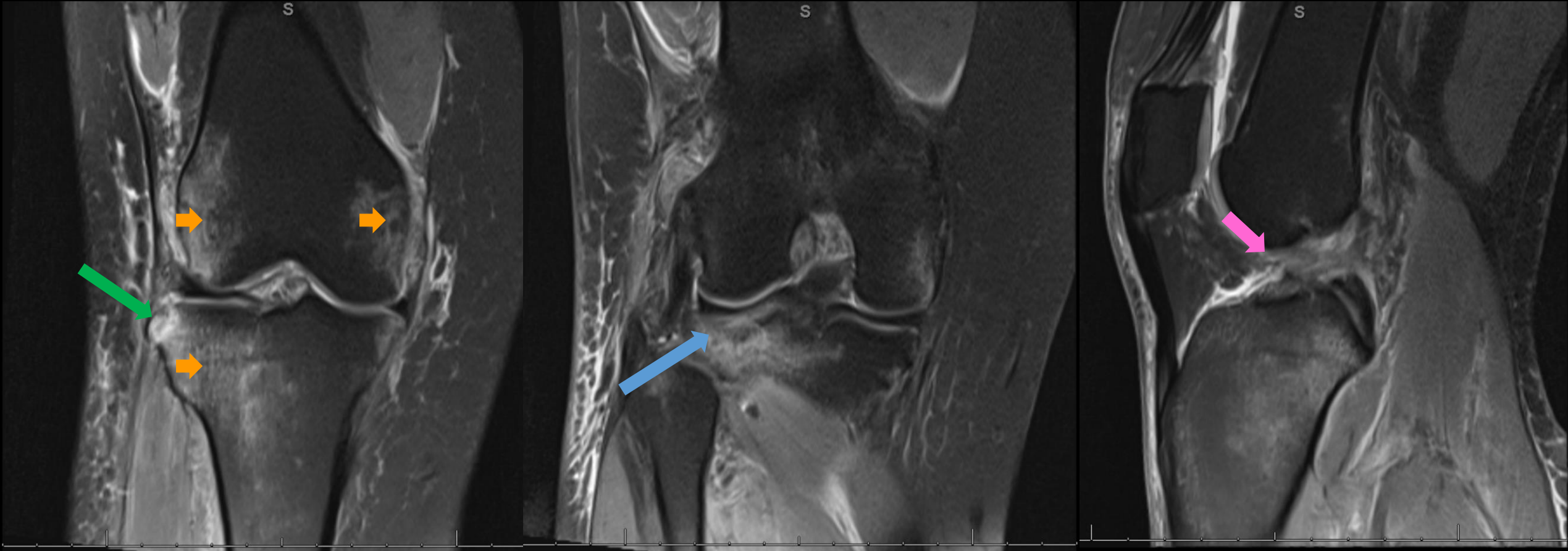


Findings: (unlabeled)



MRI knee wo contrast PDFS coronal (left), coronal oblique (middle), and sagittal (right)

Findings: (labeled)



1. Lateral tibial plateau Segond-type avulsion fracture (green) with associated marrow edema (orange)
2. Compression fracture of the posterior lateral tibial plateau (blue)
3. Complete mid-substance ACL tear (pink)

Follow-up

- Patient initially placed in a limited ROM knee brace and scheduled for outpatient follow-up with Orthopedics
- Developed severe stiffness and still had difficulty with ambulation at this visit, after which MRI was ordered and physical therapy was prescribed
- Developed DVT and subsegmental PE likely due to ambulatory status; treated medically with Xarelto
- At further Orthopedics follow-up, patient elected nonoperative management and is currently continuing physical therapy with slow progress

Final Dx:

Complete ACL Tear with Associated Extra-articular
Segond-type Avulsion Fracture of the Lateral Tibial
Plateau and Compression Fracture of the Posterior Lateral Tibial Plateau

Case Discussion

- ACL injuries are incredibly common with over 250,000 cases annually in the U.S.
- The mechanism involves **anterior and valgus stress** on a planted knee, and often coincides with injury to the MCL and medial meniscus
- History and Physical Exam findings:
 - Patients often describe **hearing or feeling a “pop” sensation**, followed by pain and swelling
 - The affected knee will usually demonstrate a **positive Lachman test and/or anterior drawer sign**
 - Lachman is more accurate for acute injuries (sens. 85%, spec. 94%) whereas anterior drawer sign is suitable for chronic injuries (sens. 92%, spec. 91%)

Case Discussion

- Imaging findings:
 - XR - ligamentous injuries are not easily identifiable on radiographs, though concomitant bony abnormality or effusion may guide further exploration; **Segond fracture** refers to a lateral tibial plateau avulsion fracture that is highly indicative of ACL injury (i.e. ~75% of the time), and its presence on XR is referred to as the **lateral capsular sign**
 - Etiology of Segond fractures are thought to be with **internal rotation and varus stress** at the knee, and may be associated with **stress on the IT band, LCL, or ALL** at the time of injury
 - **Marrow edema** (as shown in this case) can help differentiate an acute process such as a Segond fracture from a chronic LCL avulsion
 - MRI - gold standard of diagnosis for ligamentous injury to the knee, on which **fiber discontinuity or complete avulsion** can be visualized; while not essential in cases with clear ACL defect and a quality H&P, it is important in **grading of injury** and identification of **accompanying meniscal or multi-ligament injury**

Case Discussion

- Treatment options:
 - Operative treatment involves reconstruction of the ACL with the ultimate goal of recreating native ACL structure and function through ligamentization of the graft; this approach limits continued joint injury and instability, reducing the likelihood of post-traumatic osteoarthritis
 - Non-operative treatment focuses on bracing and physical therapy to reduce knee instability without undergoing a reconstructive operation; studies have shown some patients avoiding the need for a delayed elective surgery and being satisfied with functional status after non-operative management
 - Current guidelines emphasize **shared decision making** and the need for **intensive physical therapy** with either route

Case Discussion

- Major takeaways:
 - ACL injuries are **very common** but easily missed on initial survey in emergency departments as they are rarely evident on radiographs
 - Awareness of radiographic associations such as **Segond fractures** is essential to appropriate further imaging and eventual early diagnosis of ACL injury
 - Prompt orthopedic evaluation and **initiation of physical therapy** is crucial to preventing further problems associated with immobility such as DVT or pulmonary embolism (as occurred in this patient)

References:

1. Filbay SR, Grindem H. Evidence-based recommendations for the management of anterior cruciate ligament (ACL) rupture. *Best Practice & Research Clinical Rheumatology*. 2019;33(1):33-47. doi:10.1016/j.berh.2019.01.018
2. Rasuli B, Gaillard F. Segond fracture. *Radiopaedia.org*. Published online March 7, 2010. doi:10.53347/rid-8874
3. Baba Y, Radswiki T. Anterior cruciate ligament tear. *Radiopaedia.org*. Published online December 1, 2010. doi:10.53347/rid-12490
4. van der Graaff SJA, Meuffels DE, Bierma-Zeinstra SMA, et al. Why, When, and in Which Patients Nonoperative Treatment of Anterior Cruciate Ligament Injury Fails: An Exploratory Analysis of the COMPARE Trial. *Am J Sports Med*. 2022;50(3):645-651. doi:10.1177/03635465211068532
5. Diermeier T, Rothrauff BB, et al. Treatment after anterior cruciate ligament injury: Panther Symposium ACL Treatment Consensus Group. *Knee Surg Sports Traumatol Arthrosc*. 2020;28(8):2390-2402. doi:10.1007/s00167-020-06012-6