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SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Knee stiffness and arthrofibrosis

Anatomy & Pathophysiology

BONY ANATOMY

- The bones of the knee are the distal femur, the proximal tibia, and the patella [2].
- The medial femoral condyle is larger and projects farther posteriorly and distally than the lateral condyle [7].
- The lateral femoral condyle projects farther anteriorly and is wider in the medial-lateral direction than the medial femoral condyle [7].
- The tibial articular surface slopes 7° to 10° in the sagittal plane [7].
- The medial tibial plateau is larger than the lateral plateau and is concave in its frontal and sagittal planes [7].
- The lateral tibial plateau is smaller and more circular than the medial plateau, concave in the frontal plane and convex in the sagittal plane [7].
- The patella is the largest sesamoid bone in the body, averaging 2.5 cm in thickness [7].
- The patellar articular surface contains a vertical central ridge separating the broader lateral facet from the medial facet, plus a smaller medial odd facet [7].
- The posterior slope of the tibial plateau averages 10.7° in the medial plateau and 7.2° in the lateral plateau [12].
- The fibular head is located a mean of 1.5 cm distal to the joint line, with a range of 6 to 32 mm [12].

LIGAMENTS

- The anterior cruciate ligament (ACL) prevents anterior translation and rotation of the tibia on the femur [2].
- The posterior cruciate ligament (PCL) prevents posterior subluxation of the tibia on the femur [2].
- The medial collateral ligament (MCL) stabilizes the knee to valgus stresses [2].
- The lateral collateral ligament (LCL) is the main stabilizer against varus stress [2].
- The ACL is composed of 90% type I collagen and 10% type III collagen [7].

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- The mean length of the ACL is 33 mm and the mean midsubstance width is 11 mm [7].
- The ACL has two bundles: the anteromedial bundle is tight in flexion, and the posterolateral bundle is tight in extension [12].
- The PCL has a mean length of 38 mm and a mean width of 13 mm [12].
- The PCL has two bundles: the anterolateral bundle is tight in flexion, and the posteromedial bundle is tight in extension [12].
- The PCL cross-sectional area is approximately 120% to 150% greater than that of the ACL [20].
- The PCL anterolateral bundle comprises 85% of the PCL's cross-sectional area [20].
- The medial meniscus is firmly attached to the joint capsule along its entire peripheral edge [2].
- The lateral meniscus is attached to the anterior and posterior capsule but has a region posterolaterally where it is not firmly attached [2].
- The medial meniscus has less mobility than the lateral meniscus and is more susceptible to tearing when trapped between the femoral condyle and tibial plateau [2].
- The lateral meniscus is larger than the medial meniscus and carries a greater share of the lateral compartment pressure [2].
- The menisci provide shock absorption, increase congruency between joint surfaces, enhance joint stability, and aid in distribution of synovial fluid [2].
- The popliteofibular ligament is present in 90% of knees and runs from the tendon of the popliteus muscle to the styloid on the posterior fibular head [2].
- The ACL femoral attachment is a semicircular area on the posteromedial aspect of the lateral femoral condyle [7].
- The ACL tibial attachment is a broad, irregular, oval-shaped area slightly medial and anterior to the midline between the tibial spinous processes [7].
- The PCL femoral attachment is a broad, crescent-shaped area on the anterolateral aspect of the medial femoral condyle [12].
- The PCL tibial insertion is onto the posterior central sulcus, 10 to 15 mm distal to the joint line [12].
- The meniscofemoral ligaments are present in 93% of knees, with both ligaments present in 70% [12].
- The ligament of Humphrey is the anterior meniscofemoral ligament and the ligament of Wrisberg is the posterior meniscofemoral ligament [12].
- The oblique popliteal ligament arises medially as a confluence of a semimembranosus expansion and an arm of the posterior oblique ligament [20].
- The oblique popliteal ligament is usually 48 mm long, widening from 9.5 mm medially to 16.4 mm at its lateral attachment [20].

VASCULAR AND NERVE ANATOMY

- The blood supply to the knee is formed from an anastomosis around the knee derived from the descending geniculate artery, superior and inferior geniculate arteries, middle geniculate artery, and anterior tibial recurrent arteries [7].
- The middle geniculate artery supplies both the anterior and posterior cruciate ligaments [7].
- The knee is innervated by branches of the femoral nerve (L2, L3, L4), obturator nerve (L2, L3, L4), and sciatic nerve (L4, L5, S1, S2) [7].
- The posterior articular branch of the tibial nerve is the largest nerve providing innervation of the intra-articular knee [7].
- The infrapatellar branch of the saphenous nerve innervates the skin over the region of the anterior knee and proximal tibia [7].
- The popliteus artery travels through the adductor hiatus, where it is relatively immobile, and distally through the fibrous arch deep to the soleus muscle [17].
- The common peroneal nerve travels along the posterior edge of the biceps femoris and continues distally around the fibular neck [17].

MENISCI

- The menisci are C-shaped fibrocartilaginous disks with a triangular cross section [12].
- Meniscal collagen fibers are arranged obliquely, radially, and vertically [12].
- Vascular supply to the menisci is derived from the geniculate arteries, penetrating into 20% to 30% of the peripheral medial meniscus and 10% to 25% of the peripheral lateral meniscus [12].
- The medial meniscus is crescent-shaped and attaches more anteriorly and posteriorly than the lateral meniscus [12].
- The lateral meniscus is circular in shape and covers a larger proportion of the tibial plateau [12].

SYNOVIAL PLICAE

- The knee joint forms embryologically from three synovial compartments that normally fuse into a single synovial cavity [19].
- Synovial plicae represent unresolved remnants of these embryonic partitions [19].
- The medial patellar plica is the most common plica of clinical significance, with an incidence ranging from 10% to more than 50% in normal knees [19].
- A pathologic medial patellar plica is characterized by a thickened, rounded, fibrotic, and white inner border [19].
- Repetitive knee flexion and extension can cause thickening and hyalinization within the medial patellar plica, leading to loss of elasticity [19].
- A pathologic medial patellar plica may act as an abrasive band rubbing across the medial femoral condyle, potentially resulting in chondromalacia [19].

KINEMATICS

- The greatest range of motion in the knee occurs in the sagittal plane, approximately 160° [24].
- Knee rotation ranges from 45° in external rotation to 30° in internal rotation [24].
- The "screw-home" mechanism involves tibial external rotation of 5 degrees in the final 15 degrees of extension [8].
- In full extension, the knee slightly hyperextends with slight tibial external rotation while collateral and cruciate ligaments are tightened to lock the knee [25].
- The popliteus muscle initiates flexion by pulling the lateral femoral condyle backward while the medial femoral condyle slides forward, resulting in tibial internal rotation [25].
- The crossed four-bar linkage system describes the ACL and PCL as the central pivot and gear, while the menisci provide peripheral force control and braking [25].

PATHOPHYSIOLOGY OF STIFFNESS

- Loss of knee motion following distal femur fractures results from damage to the quadriceps mechanism and joint surface due to initial trauma or surgical exposure [1].
- Quadriceps scarring with or without arthrofibrosis of the knee or patellofemoral joint restricts knee movement [1].
- Immobilization of the knee for periods of more than 3 weeks usually results in some degree of permanent stiffness [1].
- Most patients should have 90 degrees of knee flexion 4 weeks postoperatively after distal femur fracture fixation [1].
- Failure to regain at least 90 degrees of knee flexion between 8 and 10 weeks postoperatively is worrisome and usually warrants additional treatment in physiologically young patients [1].
- Infection must be ruled out first for all patients with a stiff, painful total knee arthroplasty [6].
- Manipulation after total knee arthroplasty is more reliable for loss of flexion than for loss of extension [6].
- Arthroscopic resection of arthrofibrotic scarring and open débridement with tibial insert exchange has been associated with variable results [6].
- Modest gains in range of motion can be obtained with revision total knee arthroplasty along with wide resection of periarticular arthrofibrotic scarring and downsizing of the femoral implant [6].
- The posterior knee capsule originates at the proximal margin of the posterior femoral condyles and attaches below the tibial plateau [20].
- There is commonly a variably sized defect in the posteromedial joint capsule between the medial head of the gastrocnemius and the direct attachment of the semimembranosus, which is likely the cause of Baker's cysts [20].

Clinical Presentation

HISTORY

- A detailed history is imperative to diagnose the cause of knee pain [36].
- Elements of a detailed history include onset, quality, duration, tempo, and location of symptoms [36].
- Elements of a detailed history include modifying factors [36].
- Elements of a detailed history include ability to bear weight [36].
- Elements of a detailed history include history of trauma [36].

PHYSICAL EXAMINATION COMPONENTS

- A detailed physical examination of the knee includes inspection, palpation, gait assessment, range of motion testing, stability testing, neurovascular assessment, a hip examination, and special tests [36].
- Inspection of the knee can reveal skin abnormalities [36].
- Inspection of the knee can reveal evidence of trauma [36].
- Inspection of the knee can reveal malalignment [36].
- Inspection of the knee can reveal swelling [36].
- Inspection of the patient's gait may reveal abnormalities that suggest either intra-articular or extra-articular causes [36].
- Palpation of the knee with a focus on points of tenderness can alert the diagnostician to focal pathologies [36].
- Tenderness at the joint line is an example of a focal pathology identified by palpation [36].
- Tenderness over the patellar tendon is an example of a focal pathology identified by palpation [36].
- Tenderness at the pes anserine bursa is an example of a focal pathology identified by palpation [36].
- Palpation of the peripatellar tissue can reveal the presence of effusion and/or synovitis [36].
- Determination of overall knee alignment (varus, valgus, or neutral) is important as an adjunct to the diagnostic process [36].
- Malalignment can be associated with and may point to the diagnosis of specific conditions [36].
- Knee alignment should be assessed in both supine and standing positions [36].
- Bearing weight may change the knee's alignment dynamically [36].

RANGE OF MOTION

- Range of motion testing is divided into active and passive parts [36].
- Active range of motion refers to the patient's ability to move his or her own knee through range of motion [36].
- Passive range of motion refers to the examiner's ability to move the patient's knee through range of motion [36].

- Flexion contractures and hyperextension should be noted during range of motion testing [36].
- Blocks to motion can be pain-related or mechanical [36].
- When active and passive ranges of motion differ, the diagnostician must differentiate between pain-related, mechanical, or neuromuscular causes [36].
- Hip range of motion should be examined [36].
- Abnormal hip range of motion may reveal resultant knee pain, indicating the possibility of referred pain from intra-articular hip pathology [36].

STABILITY TESTING

- Stability testing of the knee can reveal ligamentous competency or deficiency [36].
- Basic varus and valgus stability testing should be performed at 0° and 30° of flexion [36].
- Firm end points indicate ligament competence [36].
- Pronounced laxity can indicate ligament deficiency [36].
- Testing at 30° of flexion isolates the MCL and LCL best [36].
- Testing in full extension engages some secondary stabilizers [36].
- ACL and PCL competence can be tested using special tests [36].

SPECIAL TESTS

- The Lachman test is used to diagnose an ACL tear [36].
- The Lachman test involves flexing the knee to 30°, holding the femur firmly, and translating the tibia anteriorly on the femur [36].
- A positive Lachman test is indicated by no firm end point and significant translation [36].
- The Posterior drawer test is used to diagnose a PCL tear [36].
- The Posterior drawer test involves flexing the knee to 90° with the patient supine, stabilizing the distal tibia, and translating the tibia posteriorly on the femur [36].
- A positive Posterior drawer test is indicated by no firm end point and significant translation [36].
- The J-sign is used to diagnose patellar maltracking [36].
- The J-sign involves bringing the knee from full extension into flexion [36].
- A positive J-sign is indicated by a visible patellar shift from lateral (subluxated) to medial (relocated) in a J-shaped path [36].
- The McMurray test is used to diagnose a lateral meniscus tear [36].
- The McMurray test for a lateral meniscus tear involves flexing the knee, internally rotating the tibia, extending the knee, and applying pressure to the lateral joint line [36].
- A positive McMurray test for a lateral meniscus tear is indicated by pain or click with the maneuver [36].
- The McMurray test is used to diagnose a medial meniscus tear [36].

- The McMurray test for a medial meniscus tear involves flexing the knee, externally rotating the tibia, extending the knee, and applying pressure to the medial joint line [36].
- A positive McMurray test for a medial meniscus tear is indicated by pain or click with the maneuver [36].
- The Dial test is used to diagnose PLC deficiency [36].
- The Dial test for PLC deficiency involves placing the patient prone with the knee flexed to 30° and externally rotating both tibiae [36].
- A positive Dial test for PLC deficiency is indicated by greater than 10° difference from the contralateral side [36].
- The Dial test is used to diagnose PLC + PCL deficiency [36].
- The Dial test for PLC + PCL deficiency involves placing the patient prone with the knee flexed to 90° and externally rotating both tibiae [36].
- A positive Dial test for PLC + PCL deficiency is indicated by greater than 10° difference from the contralateral side [36].

Investigations

PLAIN RADIOGRAPHY

- Plain radiographs are appropriate initial imaging studies for most knee conditions because they allow the assessment of traumatic injury, arthritis, patellofemoral alignment, osteochondral injury, bone neoplasm, and surgical implants [4].
- Imaging studies should include at least two perpendicular views: AP and lateral [4].
- Weight-bearing AP (extension) views are used to assess cartilage loss from the distal femur and tibial plateau [4].
- Weight-bearing PA (Rosenberg; flexion) views are used to assess cartilage loss from the posterior femur and tibial plateau [4].
- Patellofemoral views are used to assess patellofemoral alignment (tilt/subluxation), patellar and trochlear morphology, osteochondral injury, and patellofemoral arthritis [4].
- The notch view is used to assess posterior femoral cartilage, notch width, and osteophytes [4].
- Non-weight-bearing radiographs may identify acute injury without the risk of fracture displacement in trauma cases [4].
- Radiography may identify subchondral sclerosis, joint space narrowing, subchondral cysts, osteophytes, and joint subluxation in osteoarthritis [4].
- Radiography may identify joint space loss and peripheral bone erosion in inflammatory arthropathy [4].
- Radiography may identify subchondral radiolucency in osteochondral defects, most commonly in the medial femoral condyle [4].
- Radiography may identify linear radiolucency or radiodensity in stress fractures, most commonly in the proximal medial tibia [4].

- Radiography may identify a mixed sclerotic pattern with a subchondral, epiphyseal, or metaphyseal location in osteonecrosis [4].
- Radiography may identify malalignment, osteophytes, cysts, and joint space loss in patellofemoral disease [4].
- Supine AP knee radiographs do not adequately estimate the joint space width needed to estimate the degree of osteoarthritis progression [30].
- Plain frontal radiographs of the knee may not accurately display the actual joint space due to different cartilage wear patterns, meniscal integrity, or variances in tibial slopes [30].
- A 45° standing flexion view was introduced to improve evaluation of the joint space [30].
- The fixed flexion view (FFV) technique uses a fixed 10° caudal irradiation angle and fixed limb position relative to the cassette for improved reproducibility and joint space evaluation [30].
- The Lyon Schuss view (LSV) uses the same posture as the FFV but requires fluoroscopic adjustment of the irradiation angle relative to the medial tibial plateau, which is more accurate for measuring actual joint space width [30].
- The Lyon Schuss view has a higher radiation exposure dose and more complex, time-consuming positioning compared to the FFV [30].
- Goniometer readings of long limb alignment or measured on an FFV correlate well with the angle measured on long limb radiographs, providing an alternative if long limb radiographs are not available [30].
- The Kellgren-Lawrence classification uses grade I to IV of osteoarthritis severity and is frequently utilized to select the appropriate treatment and timing of intervention [30].
- Knee arthroplasty is recommended when Grade 4 findings are present on radiographs [26].

COMPUTED TOMOGRAPHY

- Computed tomography provides a three-dimensional study with enhanced bone detail using ionizing radiation [4].
- CT imaging in the axial, sagittal, and coronal planes may help visualize fracture lines and displacement, osteolytic lesions around joint arthroplasty, and cortical disruption in cases of infection or neoplasia [4].
- Three-dimensional CT reconstructions may help with preoperative planning for complex intra-articular fractures, multiplanar osteotomy for limb malalignment, and reconstitution of bone loss in joint arthroplasty [4].
- Axial plane CT imaging of the knee can help assess the rotational alignment of components of a total knee arthroplasty in cases of patellar maltracking [4].
- Three-dimensional CT with remodeling is used for preoperative planning for reconstruction associated with dysplasia, post-trauma planning, and complex total knee arthroplasty planning [26].

MAGNETIC RESONANCE IMAGING

- Increasing strength of the magnetic field (measured in Tesla units) increases the resolution of MRI images [4].

- An injected contrast agent (intravenous or intra-articular) may help delineate specific tissues of interest on MRI [4].
- MRI may suggest cruciate ligament injury through the presence of edema, intra-articular fluid, disruption of ligament fibers, and an atypical ligament contour [4].
- MRI can identify patterns of meniscal injury by location (anterior, midbody, posterior, peripheral, articular), pattern (horizontal, longitudinal, radial, complex), and displacement [4].
- MRI may identify the degree of articular cartilage injury (chondrosis, full-thickness cartilage loss), the presence of associated bone marrow edema, and the location of the injury [4].
- MRI may identify edema, avulsion, or discontinuity for extra-articular ligaments such as the MCL/LCL or associated posteromedial and posterolateral ligamentous complexes [4].
- MRI may be used to assess the continuity of the quadriceps or patellar tendon [4].
- MRI may be used to assess the margin of resection for a neoplasm, identify vascular malformation, or define the location of nerves or vessels relative to popliteal cysts [4].
- MRI is the most useful study for differentiating osteonecrosis from other conditions such as osteochondritis dissecans, transient osteoporosis, bone bruises, or occult fractures [32].
- A serpentine lesion within a well-demarcated border is a specific finding on MRI for osteonecrosis [32].
- Bone edema on MRI is a common feature of osteoarthritis, osteonecrosis, cartilage injury, and transient regional osteoporosis [32].
- MRI is grossly overused in the arthritic patient population [26].
- If the joint space is significantly narrowed on radiograph, MRI is not indicated for knee arthritis assessment [26].
- MRI is used when osteonecrosis is suspected in the arthritic patient population [26].
- Compositional MRI techniques (T1ρ, T2*, dGEMRIC, gagCEST) are used for early recognition of cartilage degeneration [23].
- A systematic review quantified the accuracy of MRI for detection of meniscal injury and ACL tear [23].

NUCLEAR MEDICINE

- Nuclear medicine involves labeled radionuclide injection followed by delayed imaging of gamma radiation, where areas of increased concentration appear bright or “hot” [4].
- Nuclear medicine provides a nonspecific study that does not define the etiology of an abnormality but rather the presence of an abnormality that may correlate with a clinical concern [4].
- Increased radionuclide activity in bone may be a normal postoperative finding for up to 6 to 12 months after a fracture repair or arthroplasty [4].
- Technetium-99 (Tc-99) is a radionuclide that may help identify infection, neoplasia, occult fracture, bone healing, active phases of heterotopic ossification, implant loosening, or failure of osseointegration [4].
- Gallium-67 (Ga-67) is a radionuclide that may help differentiate between aseptic and septic prosthetic loosening, requiring 24 to 72 hours for a complete study [4].

GENERAL ASSESSMENT

- Radiographic studies help confirm the clinical diagnosis of a joint disorder determined using the patient's history and physical examination [4].
- Advanced radiographic imaging studies may help assess overall limb alignment and further delineate intra-articular and extra-articular soft tissues, including cartilage, menisci, ligaments, tendons, muscles, and nerve and vascular structures [4].
- Physical examination along with radiographic or advanced imaging findings must be used concomitantly to determine the source of symptoms and appropriate surgical intervention [10].
- Assessment of the joint must combine physical examination along with radiographic (including full-length alignment views) and MRI findings for cartilage injury [33].
- Radiographic evaluations are essential when diagnosing an osteochondritis dissecans (OCD) lesion of the knee, although important aspects of the OCD lesions may be better seen with MRI [29].
- Assessing the potential instability of an OCD lesion is key to early treatment [29].

Treatment

NON-OPERATIVE MANAGEMENT

- Patients who fail to regain knee motion during the first month after distal femur fracture fixation are best treated with aggressive range-of-motion exercises under the direction of a physician and physical therapist [1].
- Immediate mobilization of the knee is essential to maintain knee motion following arthroscopic lysis of adhesions [1].
- Early rehabilitation including passive-assisted and active-assisted ROM is important to avoid limited motion after total knee arthroplasty [6].
- Patients who begin ROM therapy within 4 weeks of surgery for tibial spine fractures have substantially faster return to full activity and are less likely to experience the development of arthrofibrosis than patients for whom ROM rehabilitation was initiated after 4 weeks [5].
- Persistent neurogenic pain associated with stiffness after revision total knee arthroplasty should be treated with a multimodal pain management approach, local or epidural injections, and manipulation [6].
- The response to treatment for persistent neurogenic pain after revision total knee arthroplasty is often poor and requires a long-term pain management program [6].

OPERATIVE MANAGEMENT

- Failure to regain at least 90 degrees of knee flexion between 8 and 10 weeks postoperatively after distal femur fracture fixation is worrisome and usually warrants additional treatment in physiologically young patients [1].

- Arthroscopic lysis of adhesions combined with gentle manipulation of the knee is an approach to regain functional knee motion in patients with distal femur fractures who fail to regain 90 degrees of flexion between 8 and 10 weeks postoperatively [1].
- Forceful manipulation should be avoided when treating knee stiffness following distal femur fractures [1].
- Patients with significant loss of motion after open distal femur fractures may be candidates for quadricepsplasty as a late reconstructive procedure [1].
- In a study of 205 pediatric patients treated surgically for a displaced tibial spine fracture, arthrofibrosis developed in 20 patients (10%) [5].
- Arthrofibrosis in pediatric tibial spine fracture patients is defined as 10° extension loss and/or less than 90° flexion at 3 months postoperatively [5].
- Patients with arthrofibrosis after pediatric tibial spine fracture surgery were treated with a second surgical procedure, which usually involved a combination of arthroscopic lysis of adhesions followed by manipulation under anesthesia [5].
- Of eight pediatric patients treated with manipulation under anesthesia alone for postoperative arthrofibrosis, three sustained an intraoperative distal femoral physeal fracture [5].
- Isolated manipulation under anesthesia for postoperative arthrofibrosis in the skeletally immature knee should be undertaken with extreme caution because of the documented risk of physeal injury [5].
- In a 2012 study of 40 patients treated surgically for a displaced tibial spine fracture, arthrofibrosis developed in 7 of the 40 patients (17.5%), necessitating a second surgery [5].
- If motion remains restricted after total knee arthroplasty, manipulation or, occasionally, revision surgery for arthrofibrosis may be necessary [6].
- Manipulation is more reliable for loss of flexion than for loss of extension after total knee arthroplasty [6].
- Arthroscopic resection of arthrofibrotic scarring and open débridement with tibial insert exchange has been associated with variable results for stiffness after total knee arthroplasty [6].
- Modest gains in ROM can be obtained with revision total knee arthroplasty along with wide resection of periarticular arthrofibrotic scarring and downsizing of the femoral implant, although pain may still persist [6].
- Surgical treatment of a chronically painful total knee arthroplasty with no mechanical source or evidence of infection is usually associated with a poor outcome [6].
- Excision of heterotopic bone is usually successful for treating stiffness caused by established heterotopic ossification after knee dislocation [34].
- Excision of heterotopic bone is likely best done after the acute period of ossification has passed (usually approximately 3 months) and metabolic activity (based on serial bone scans) has normalized [34].
- Manipulation of the joint may not be helpful in restoring motion in cases of established heterotopic ossification after knee dislocation [34].

Complications

DISTAL FEMUR FRACTURES

- Loss of knee motion is a common complication following distal femur fractures [1].
- Knee stiffness after distal femur fractures results from damage to the quadriceps mechanism and joint surface due to initial trauma or surgical exposure [1].
- Quadriceps scarring with or without arthrofibrosis of the knee or patella–femoral joint restricts knee movement [1].
- Some component of knee stiffness is common in open distal femur fractures [1].

TIBIAL SPINE FRACTURES

- Knee stiffness is a commonly reported complication after treatment of tibial spine fractures [5].
- Arthrofibrosis developed in 20 of 205 pediatric patients (10%) treated surgically for a displaced tibial spine fracture [5].
- Arthrofibrosis in the pediatric tibial spine fracture study was defined as 10° extension loss and/or less than 90° flexion at 3 months postoperatively [5].
- The average time to surgery for the pediatric patients who developed arthrofibrosis was 8.1 days [5].
- Postoperative immobilization for the pediatric patients who developed arthrofibrosis was generally 4 to 6 weeks [5].
- Arthrofibrosis developed in 7 of 40 patients (17.5%) treated surgically for a displaced tibial spine fracture in a 2012 study [5].
- Patients who began ROM therapy within 4 weeks of surgery were less likely to experience the development of arthrofibrosis than those for whom ROM rehabilitation was initiated after 4 weeks [5].
- Three of eight patients treated with manipulation under anesthesia alone for postoperative arthrofibrosis in the skeletally immature knee sustained an intraoperative distal femoral physeal fracture [5].

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