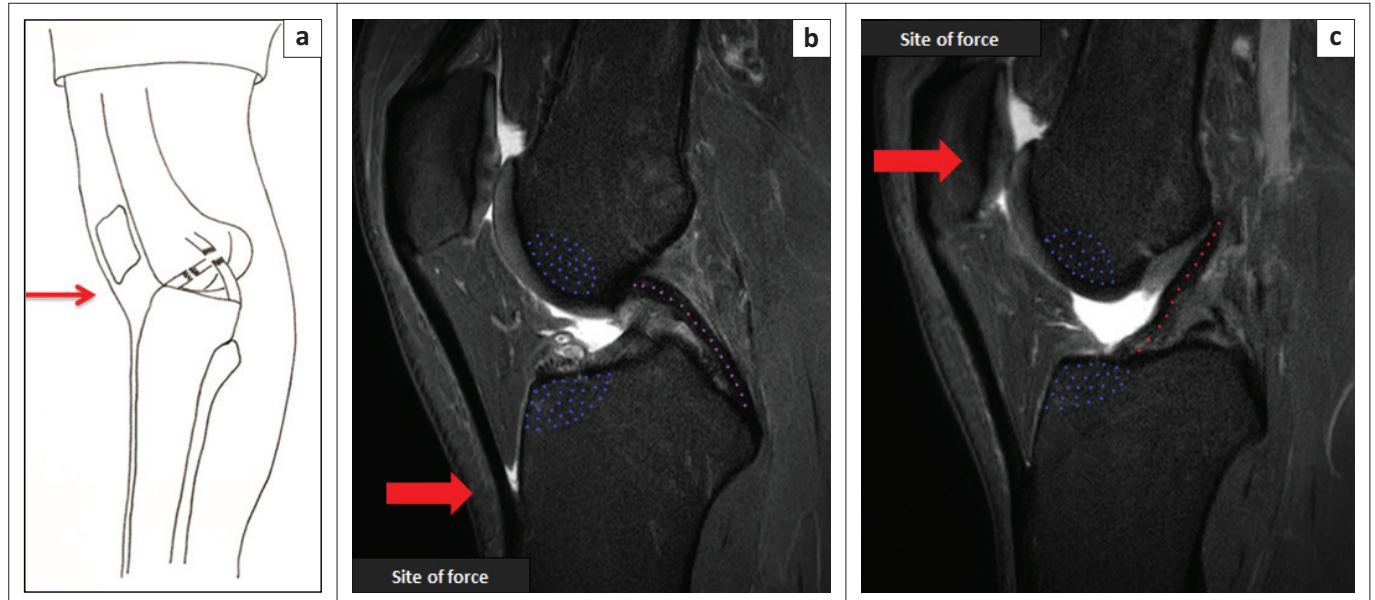


## Online Appendix 1

### Quick reference guide for the identification of knee injury mechanism at MRI adapted from a classification compilation<sup>1</sup>

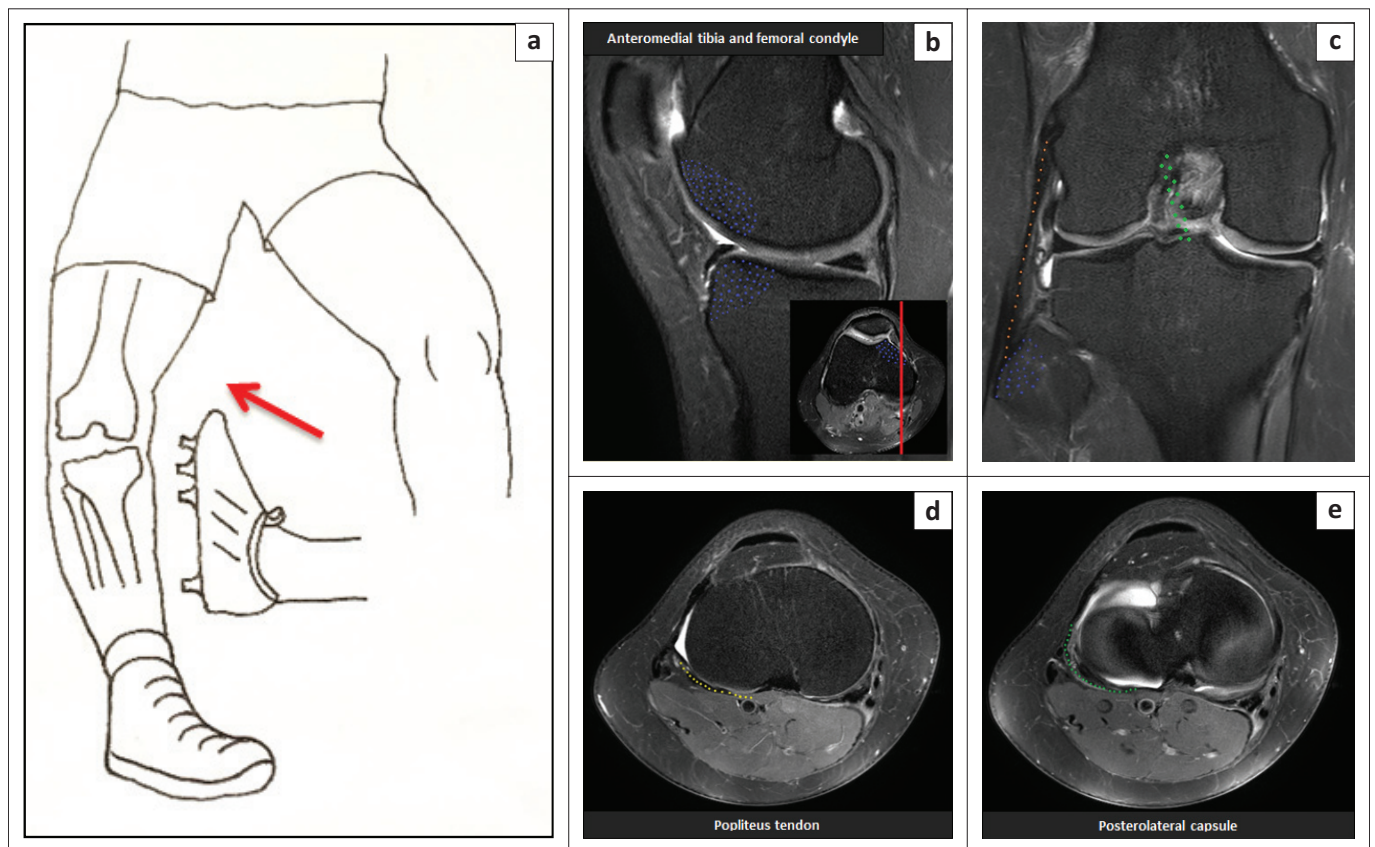
Sites of injury are depicted with colour overlay on a normal right knee MRI scan.



PCL, posterior cruciate ligament; ACL, anterior cruciate ligament.

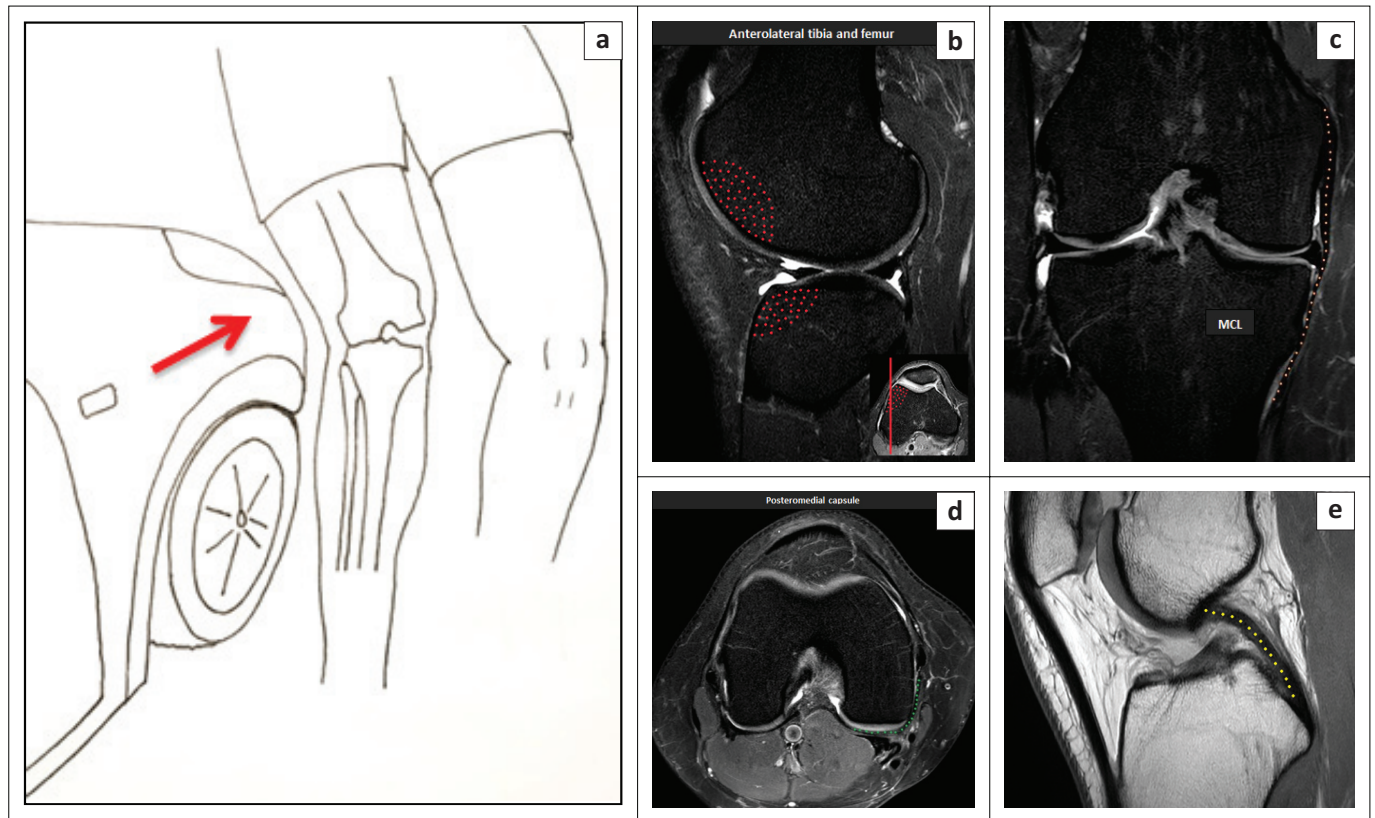
Note: Associated with either anterior tibial translation (ACL tear) or posterior tibial translation (PCL tear). Frequency 2%.

**FIGURE 1:** Pure hyperextension: (a) Schematic depicts site of force at anterior knee, (b) and (c) depict anterior central tibia, and anterior femoral condyle impact bone bruises with posterior cruciate ligament (b) and anterior cruciate ligament (c) tear. Posterior capsule may also be injured.



Note: Unstable posterolateral corner injury. Frequency 8%.

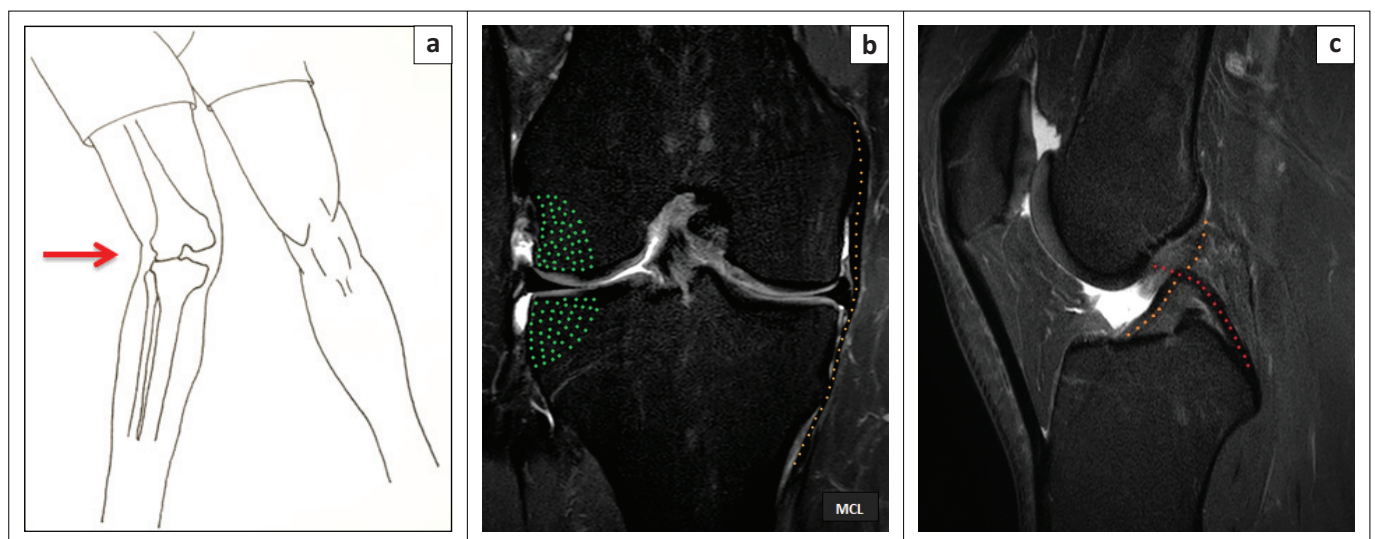
**FIGURE 2:** Hyperextension with varus: (a) Schematic depicts anteromedial impact with posterolateral force, (b) right knee anteromedial tibia and femoral condyle impactions, (c) lateral collateral ligament injury with proximal fibula avulsion oedema, and possible anterior cruciate ligament injury, and (d) and (e) show posterolateral corner disruption which may include popliteus and posterolateral capsule injuries.



ACL, anterior cruciate ligament.

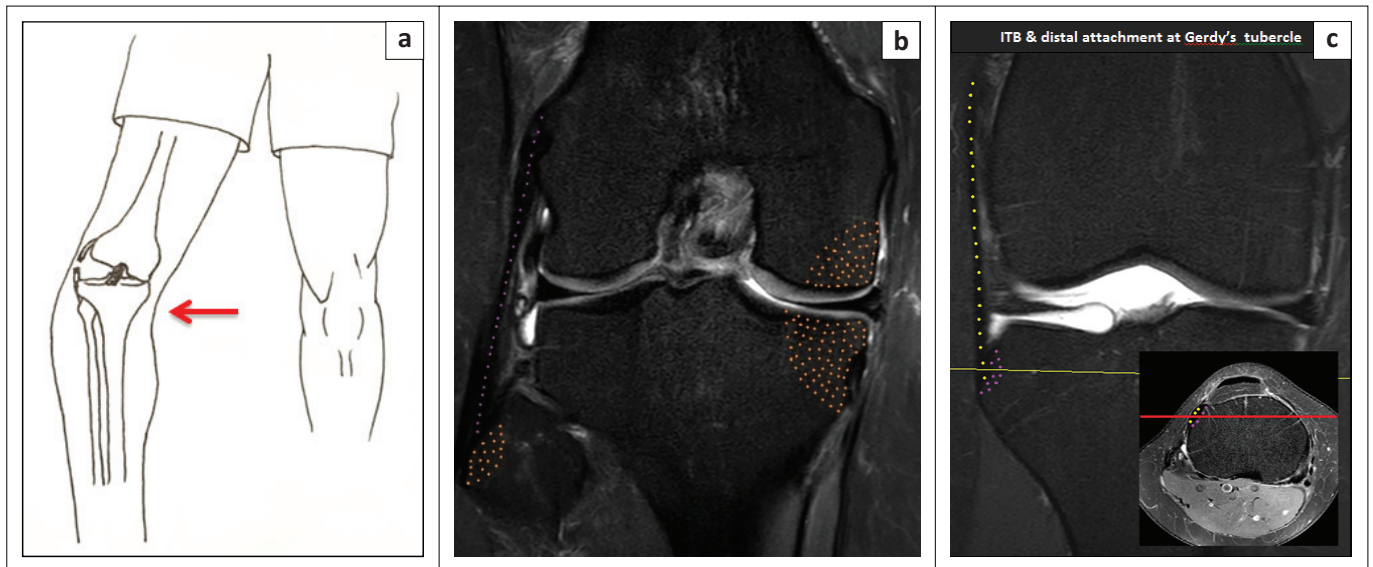
Note: Contiguous ('kissing') bone marrow oedema pattern aids in distinguishing lateral impact from typical non-contiguous ACL injury pattern (flexion, valgus and external rotation). Frequency 2%.

**FIGURE 3:** Hyperextension with valgus: (a) Schematic depicts anterolateral impact with posteromedial force, (b) contiguous right knee anterolateral tibia and femoral condyle impactions, (c) medial collateral ligament injury, (d) posteromedial capsular injury, where there may be posteromedial tibia avulsion bone oedema, and (e) depicts posterior cruciate ligament injury.



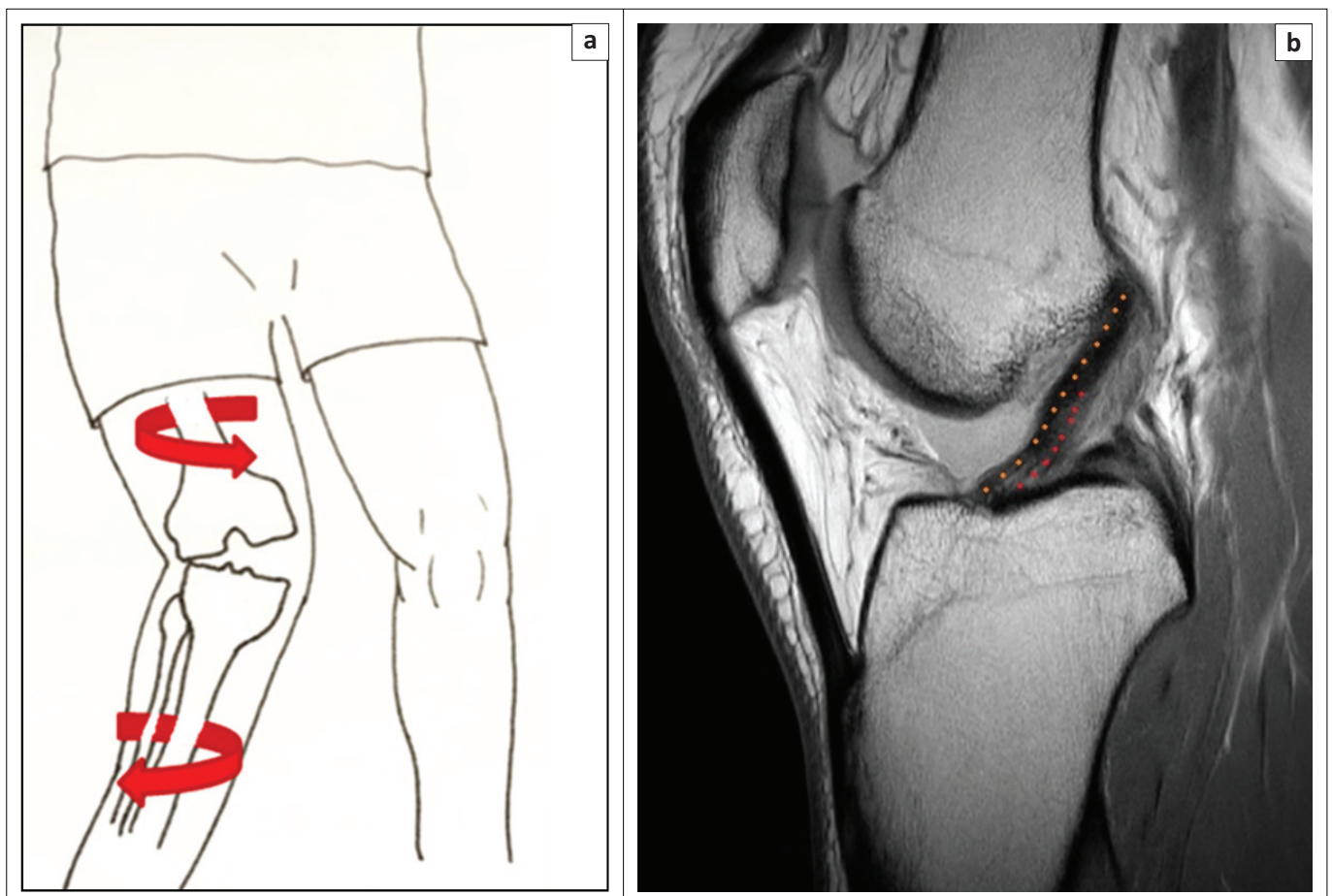
Note: Pure pattern is uncommon. Frequency 6%.

**FIGURE 4:** Pure valgus: (a) Schematic depicts medially directed force, (b) right knee lateral tibia, and lateral femoral condyle impactions, with medial collateral ligament injury, and (c) anterior cruciate ligament or posterior cruciate ligament injury may be present depending on severity of force.



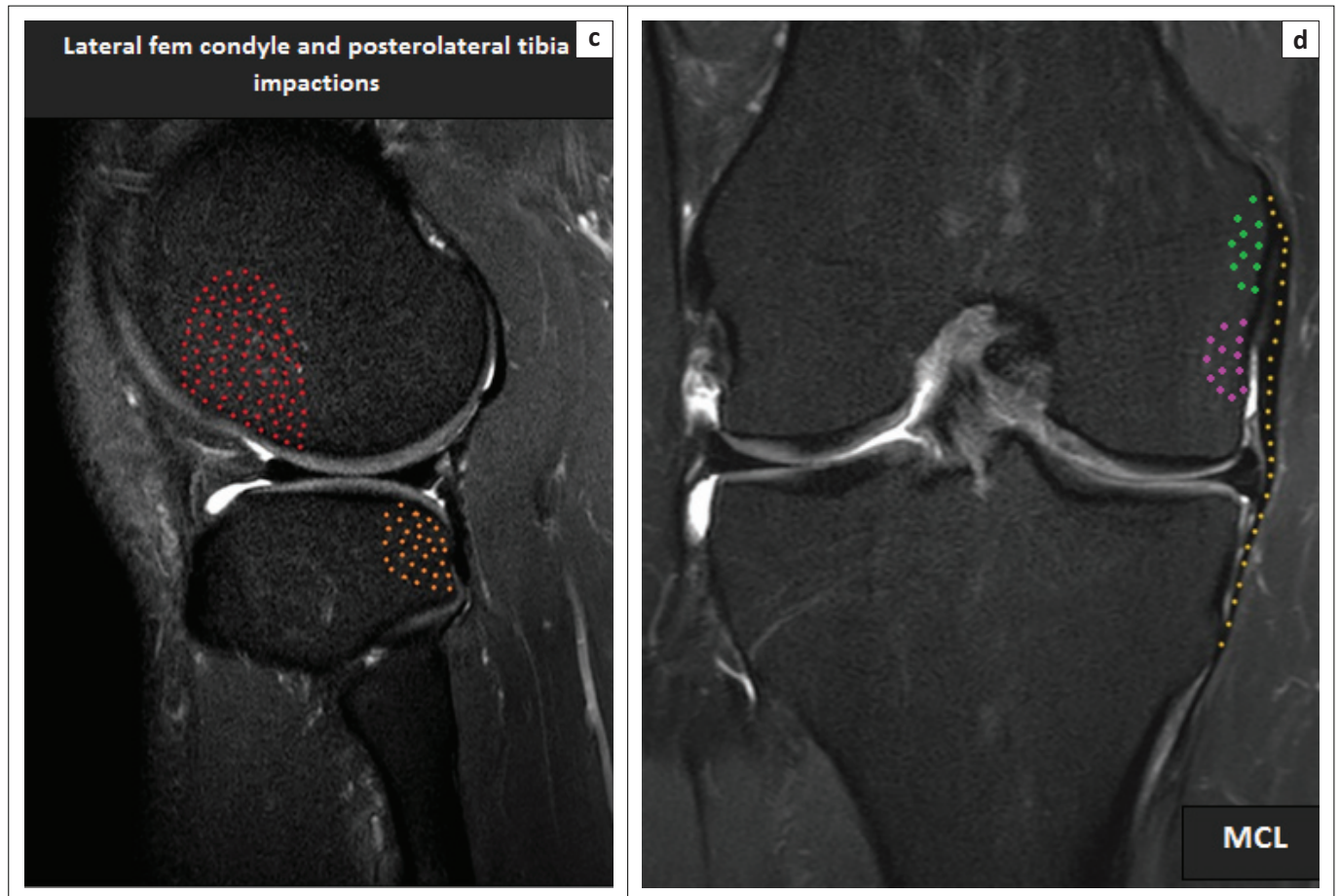
Note: Rarely seen pattern, as varus is usually associated with flexed position and internal rotation. Frequency 1%.

**FIGURE 5:** Pure varus: (a) Schematic depicts laterally directed force, (b) right knee medial tibia and femoral condyle impactions, and lateral collateral ligament injury, possibly with fibular head avulsion oedema, and (c) iliotibial band injury with possible avulsion oedema at Gerdy's tubercle.



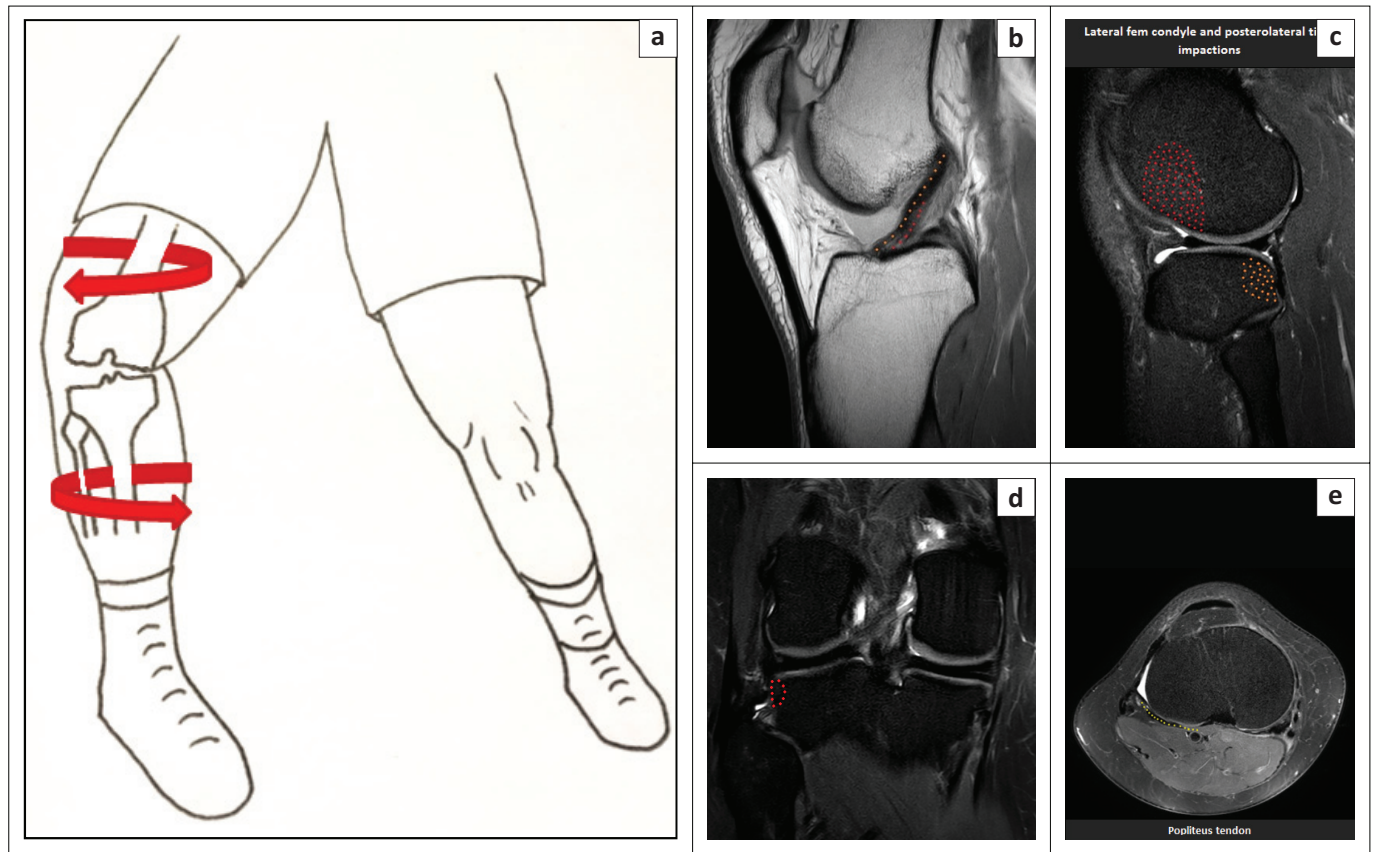
Note: Medial and lateral menisci at risk. Posteromedial tibia and femoral condyle avulsion oedema may also be seen. Frequency 46%.

**FIGURE 6:** Flexion, valgus and external rotation: (a) Schematic depicts excessive sudden internal rotation of femur on 'fixed' tibia (effective external tibial pivot) with knee in flexed valgus position, (b) anterior cruciate ligament (ACL) tear that results from excessive rotation, (c) non-contiguous impactions at the lateral femoral condyle and posterolateral tibia that occur once the ACL has given way and (d) right knee medial collateral ligament (MCL) tear which is often incomplete; look for avulsion bone bruise at deep (purple) and superficial (green) MCL portion attachments.



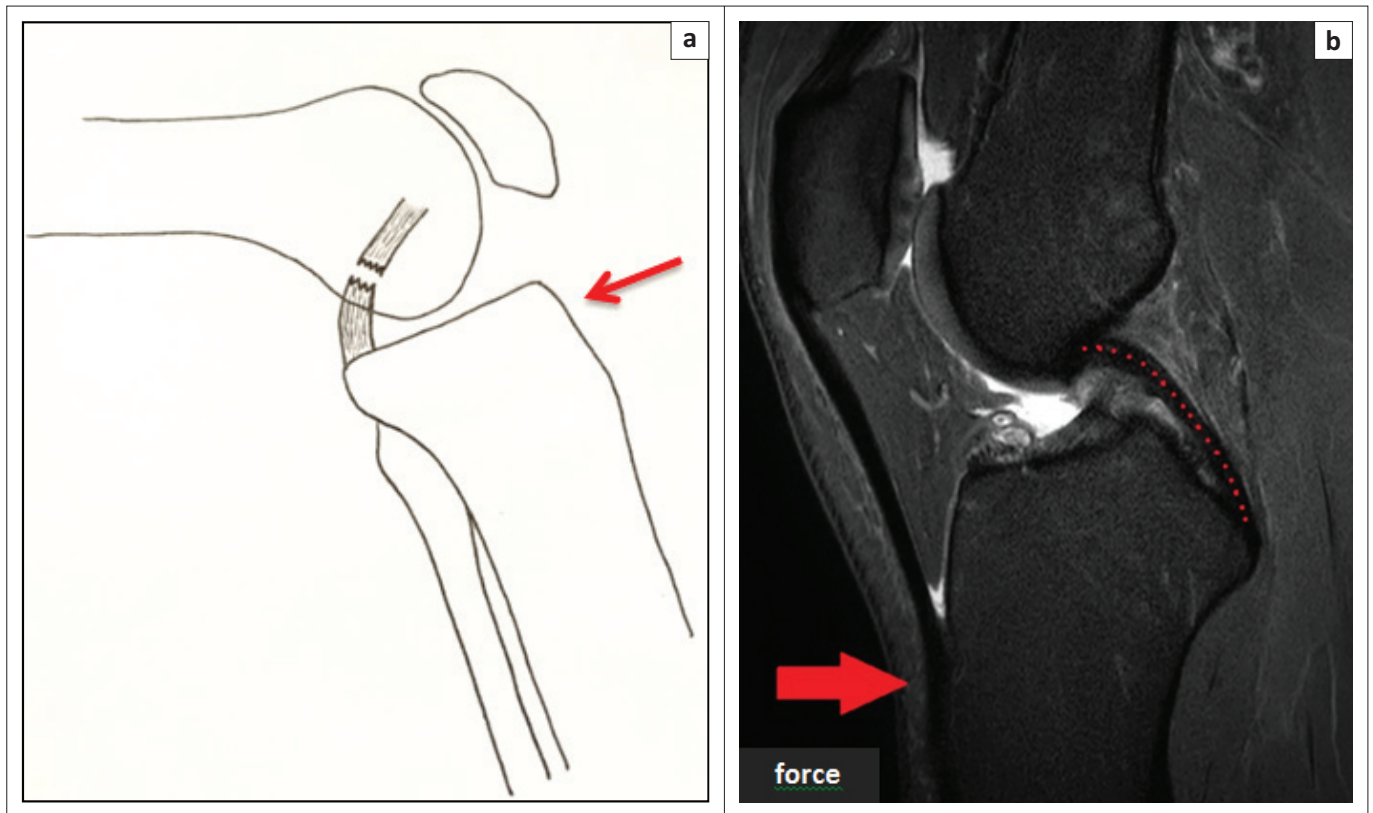
Note: Medial and lateral menisci at risk. Posteromedial tibia and femoral condyle avulsion oedema may also be seen. Frequency 46%.

**FIGURE 6 (Continues ...):** Flexion, valgus and external rotation: (a) Schematic depicts excessive sudden internal rotation of femur on 'fixed' tibia (effective external tibial pivot) with knee in flexed valgus position, (b) anterior cruciate ligament (ACL) tear that results from excessive rotation, (c) non-contiguous impactions at the lateral femoral condyle and posterolateral tibia that occur once the ACL has given way and (d) right knee medial collateral ligament (MCL) tear which is often incomplete; look for avulsion bone bruise at deep (purple) and superficial (green) MCL portion attachments.



Note: Lateral and medial menisci at risk. Frequency 1%.

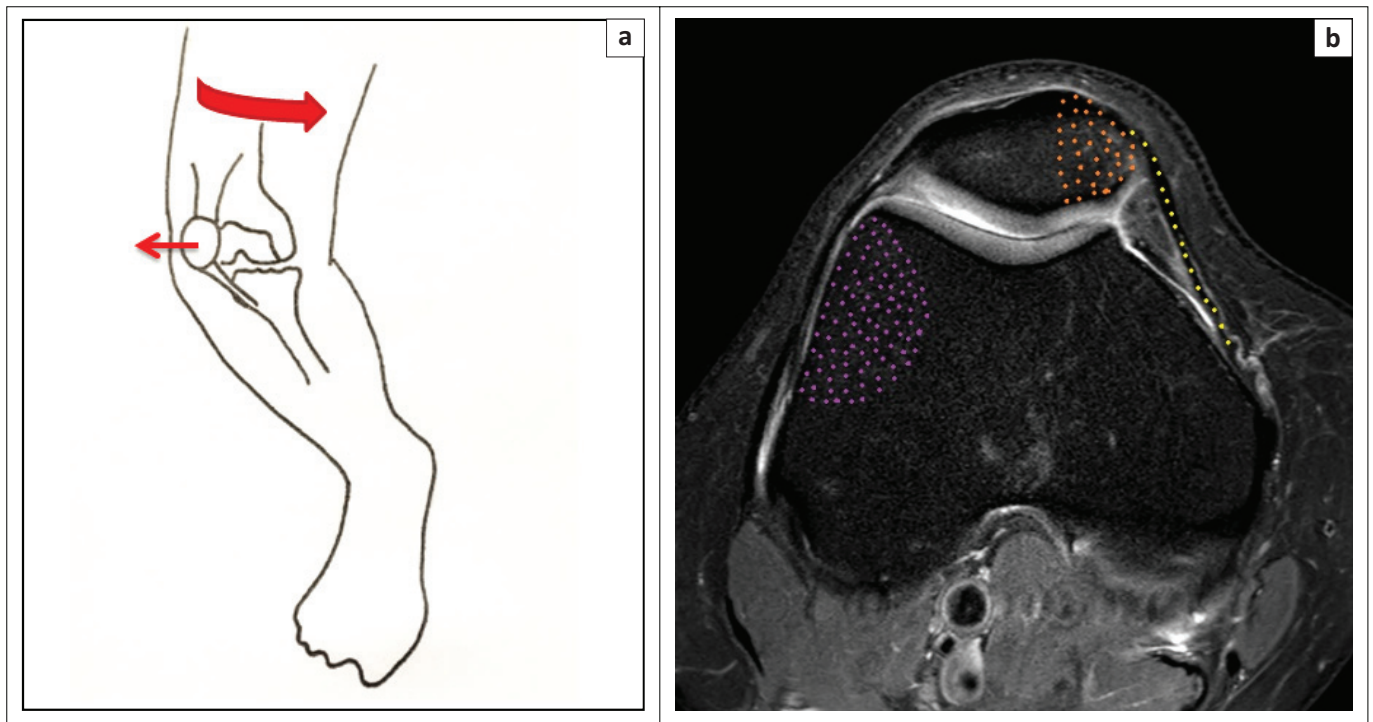
**FIGURE 7:** Flexion, varus and internal rotation: (a) Schematic depicts excessive sudden external rotation of the femur relative to tibia (effective internal tibial pivot) with knee in flexed position with varus stress on lower leg, and results in stress on the lateral supporting structures, and thus the commonly associated Second fracture at the posterolateral tibial margin, (b) excessive rotation of the knee causes anterior cruciate ligament (ACL) disruption (stabiliser against rotation), (c) non-contiguous impactions at the lateral femoral condyle and posterolateral tibia that occur once the ACL has given way, (d) right knee site of Second fracture (avulsion fracture at attachment of lateral collateral ligament anterior band) and (e) posterolateral corner injury (popliteus tendon  $\pm$  posterolateral capsule injury).



PCL, posterior cruciate ligament.

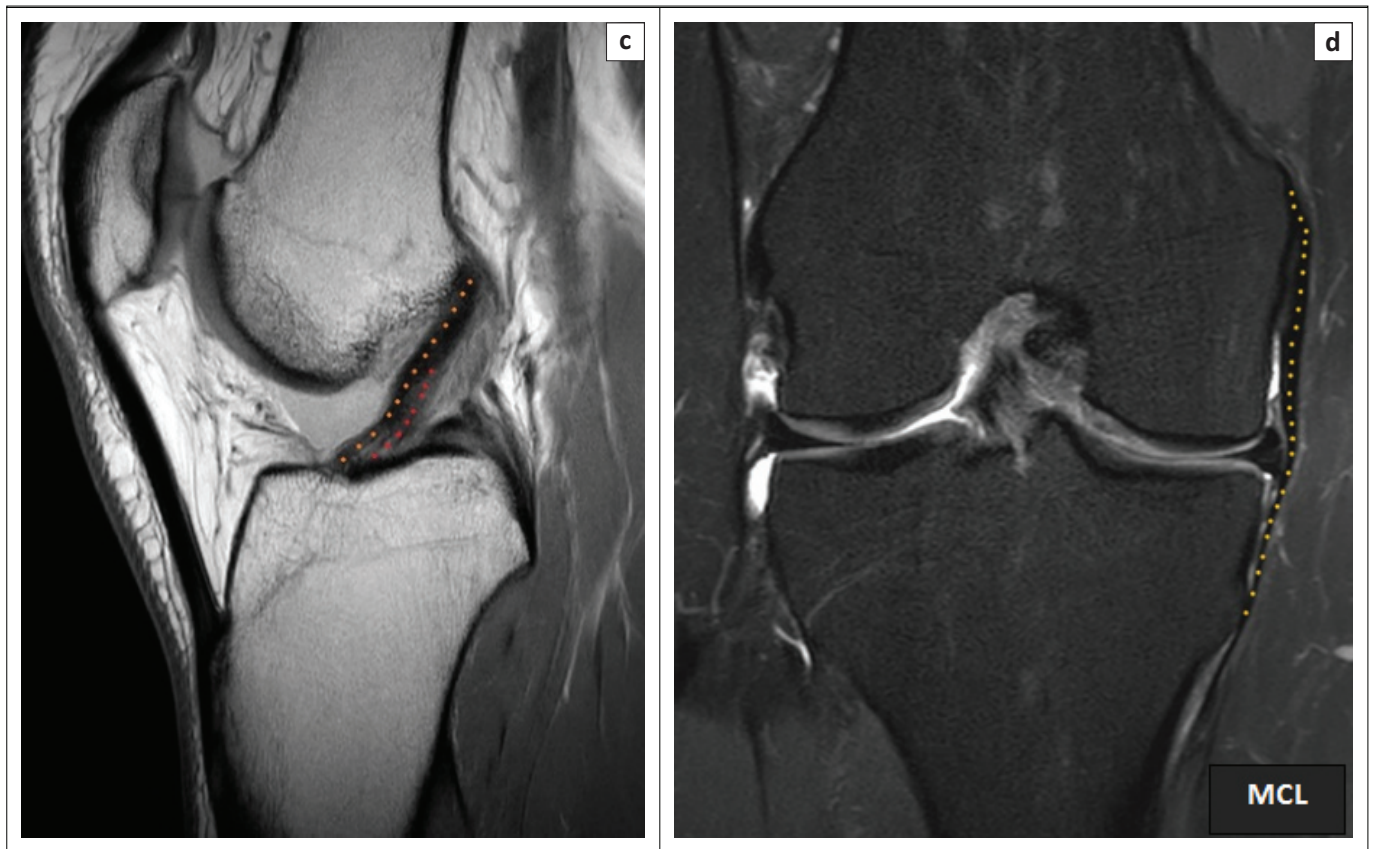
Note: Most common mechanism for isolated PCL tear. Frequency 8%.

**FIGURE 8:** Flexion, with posterior tibial translation: (a) Schematic depicts direct posterior force on flexed tibia (no bone bruise unless severe force or associated with axial load) and (b) posterior cruciate ligament injury; posterior dislocation can occur with severe force.



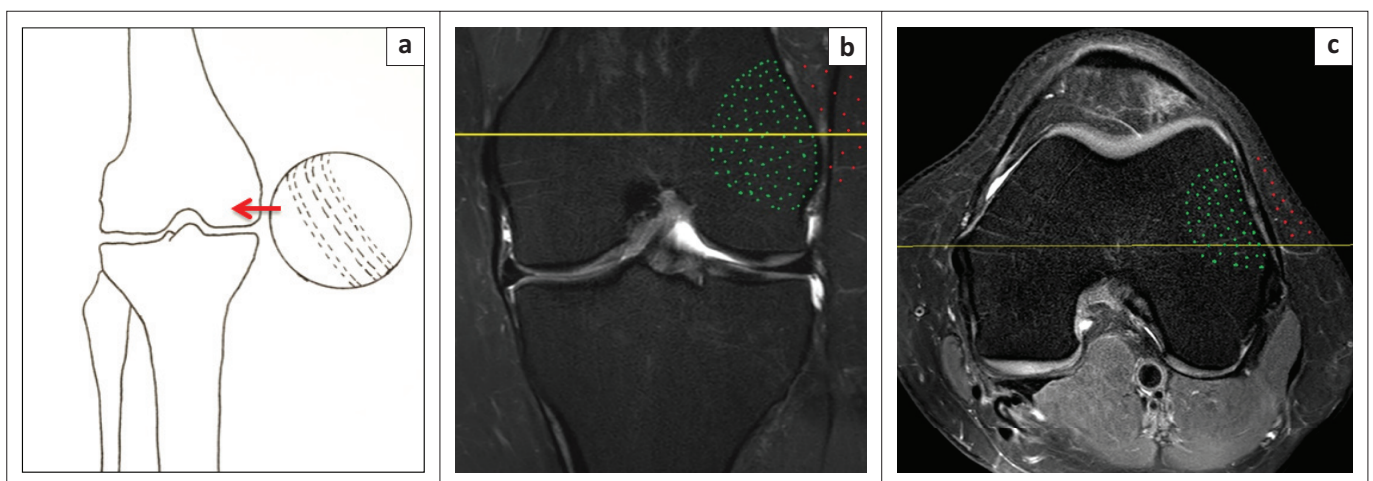
Note: Search for chondral defect, often associated with predisposing conditions (e.g. patella alta). Frequency 6%.

**FIGURE 9:** Patellar dislocation: (a) Schematic depicts flexion and internal rotation of femur on fixed tibia, (b) medial patella and lateral femur condyle impactions, and (c) and (d) show anterior cruciate ligament and MCL injury respectively, which may occur with sufficient force.



Note: Search for chondral defect, often associated with predisposing conditions (e.g. patella alta). Frequency 6%.

**FIGURE 9 (Continues ...):** Patellar dislocation: (a) Schematic depicts flexion and internal rotation of femur on fixed tibia, (b) medial patella and lateral femur condyle impactions, and (c) and (d) show anterior cruciate ligament and MCL injury respectively, which may occur with sufficient force.



Note: Generally no ligamentous injury. May have superficial soft tissue injury adjacent to bone contusion. Frequency 5%.

**FIGURE 10:** Direct trauma: (a) Schematic depicts direct trauma to medial right knee with associated soft tissue contusion and bone bruise depicted in the medial femur condyle (b) and (c).

## Reference

1. Hayes CW, Brigido MK, Jamadar DA, Propeck T. Mechanism-based pattern approach to classification of complex injuries of the knee depicted at MR imaging. *RadioGraphics*. 2000;20:S121–S134. [https://doi.org/10.1148/radiographics.20.suppl\\_1.g00oc21s121](https://doi.org/10.1148/radiographics.20.suppl_1.g00oc21s121)

Note: This is the online appendix of Stutterheim J, Goodier MD. Reliability assessment of a mechanism-based approach to post-injury knee magnetic resonance imaging interpretation by general radiologists. *S Afr J Rad*. 2018; 22(1), a1253. <https://doi.org/10.4102/sajr.v22i1.1253>