OVERVIEW

Knee is caught in the middle between the foot and the hip

Knee has few places to go and nowhere to hide

Knee is the foot (lower leg) and the hip (femur)

Knee has motion in all three planes
Sagittal Plane – Gravity and GRF cause knee to flex

  Flexion continues as part of hip flexion (femur) and ankle dorsiflexion (lower leg)

Frontal Plane – Gravity and GRF cause calcaneus to evert which creates frontal plane motion of lower leg (proximal end goes in) and femur (distal end goes in)

Combined with physical forces, this creates abduction motion and abducted (valgus) position

Transverse Plane – Eversion of calcaneus allows talus to drop down and in. The “IN” is transverse plane internal rotation

This drives the lower leg and femur to internally rotate, with the lower leg rotating faster, producing joint internal rotation
Loading motions of knee flexion, knee abduction, and knee internal rotation are created by physical forces.

Loading motions are decelerated by all the muscles.

Force captured by deceleration is transformed into the TZ1 explode.

The TZ1 explode is transformed into the TZ2 load.
Sagittal Plane – Extension motion from flexed position to heel rise
  Forward motion of proximal tibia is slowed
  Forward motion of proximal femur is accelerated
  Motion is extension but positioned not hyperextended

Frontal Plane – Adduction motion from abducted position
  Distal end of femur moves out (hip abduction)
  Proximal end of lower leg moves out (inversion)
  Motion is adduction but knee usually is still abducted
  or neutral (rarely in adducted position)

Transverse Plane – Inversion causes talus to rotate out, causing
  external rotation of lower leg
  Swinging leg causes pelvis to rotate towards back leg
  Pelvis causes femur to externally rotate, the same as the
  lower leg, but femur is moving faster causing knee joint
  internal rotation
SUMMARY

Relative knee joint motions during TZ1 load
Flexion, Abduction, Internal Rotation

Relative knee joint motions during TZ2 load
Extension, Adduction, Internal Rotation