Healthy Actions for the Knees in Yoga

For Yogaversity with Doug Keller

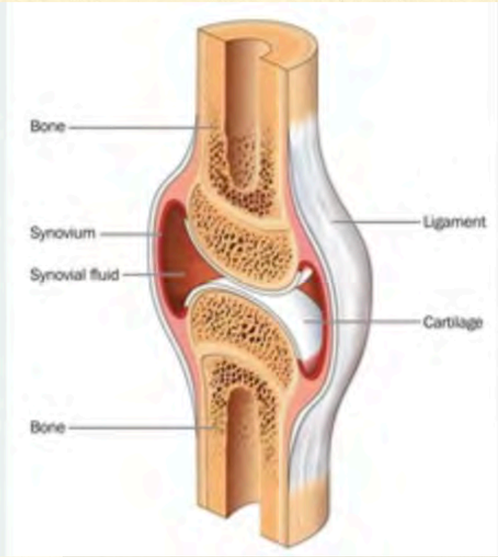
doyoga.com/yogaversityknees.pdf

The Key to Understanding Joint Pain:

Joint Play

Joint play depends upon maintaining ***space*** in the joint:

- there has to be some ***space*** within the joint capsule for the bones to move or ***float*** freely — to shift around slightly — ***prior*** to any action by the muscles.



Most joints in the body are '**synovial' joints,** in which an outer **capsule** encloses the synovial fluid within the joint capsule.

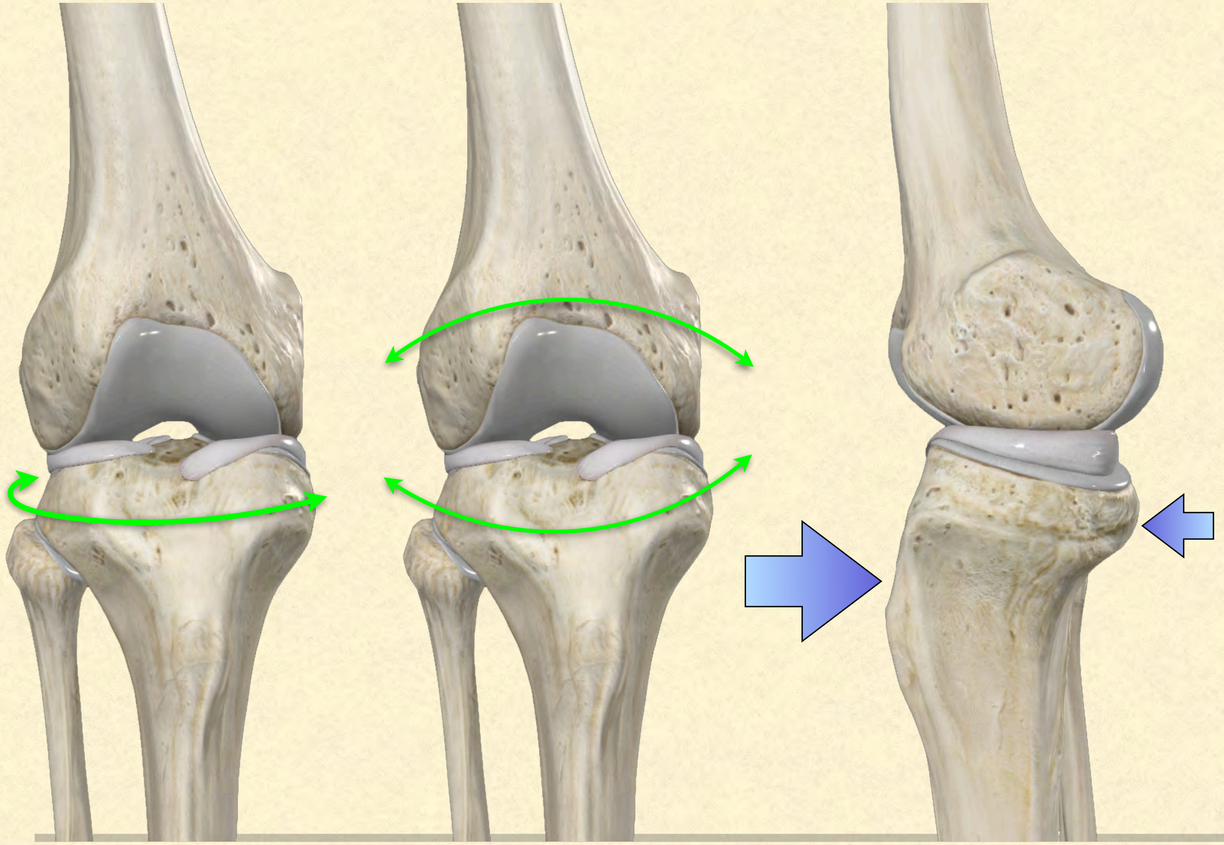
This fluid supports healthy cartilage, providing smooth, slippery movement between the bones without wear and tear to either the bones or cartilage.

Joint ***pain*** seems to come from the ***loss*** of one or more movements in the joint that is ***prior*** to voluntary muscle action.

This **normal range of movement** (which has been lost) is called '**joint play**.'

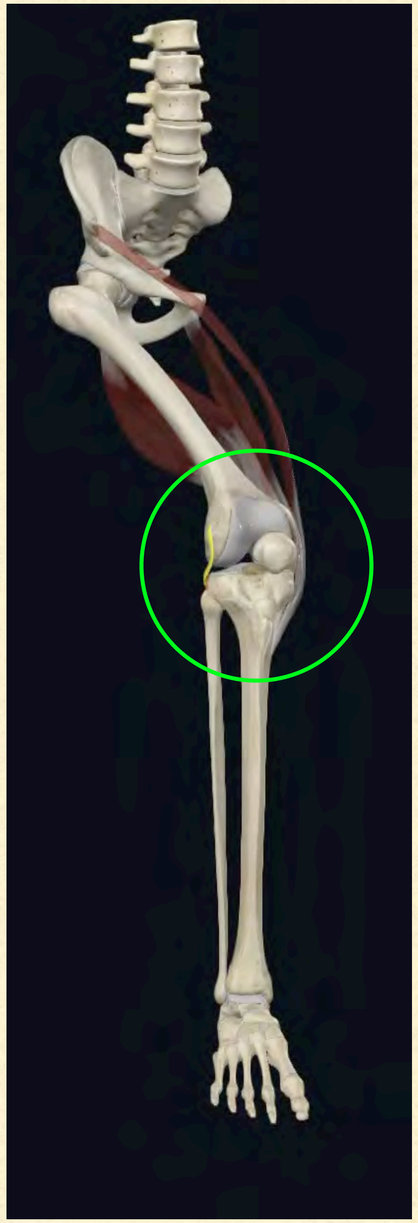
Joint Play:

The Knee Needs Space



The necessary joint play movements are:

1. Rotation of the Tibia on the Femur
2. Side-tilt
3. Forward-Backward Slide of the Tibia on the Femur



Rotation

The Vulnerability of the Knee:

Its Elegant Design: a 'Twisty' Hinge

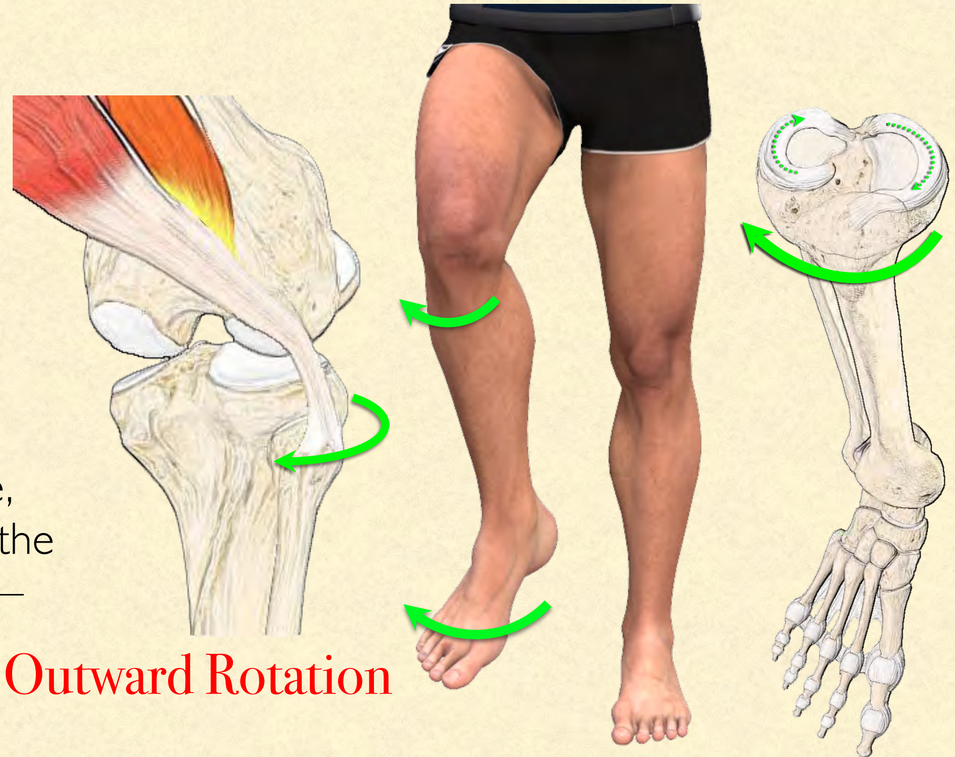
The knee is more than just a hinge joint that bends and straightens: it is a 'twisty' hinge.

The more we bend the knee, the more the bones of the lower leg — tibia and fibula — are capable of rotating or twisting.

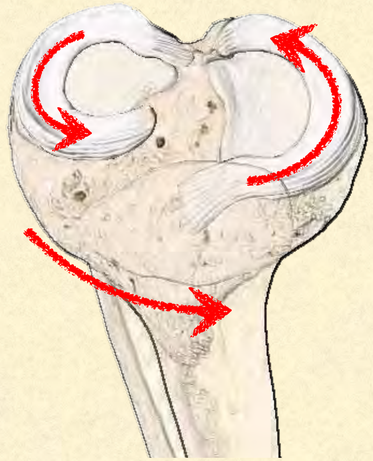
The collateral ligaments ***prevent*** the tibia from rotating when the leg is **straight**.

The ability of the tibia to rotate comes from its **asymmetrical design**:

the two condyles of the femur are different in size, shape and level, allowing the tibia to slide and rotate — especially outward.

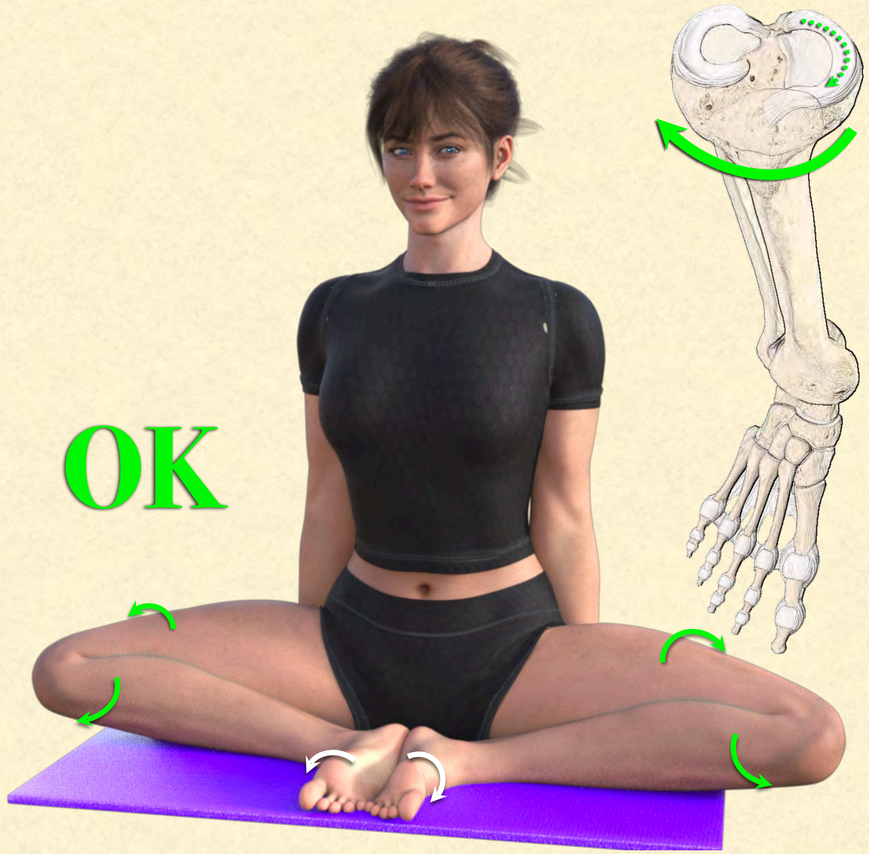


Outward Rotation



The shape of the bones and meniscus is designed to allow outward rotation of the shin when the knee is bent, but NOT inward rotation. This inward rotation is harmful to the ligaments, and destabilizes the knee.

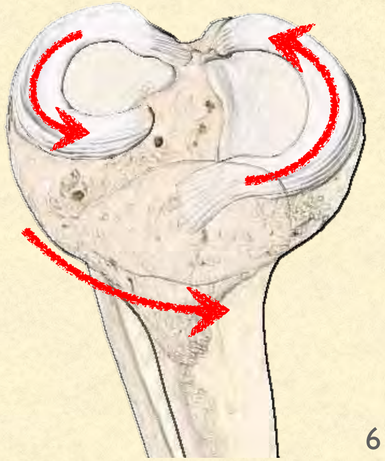
Inward Rotation
Stresses the Meniscus



Foot Supination Encourages External Shin Rotation: Safer for the Knees

Forced Internal Shin Rotation

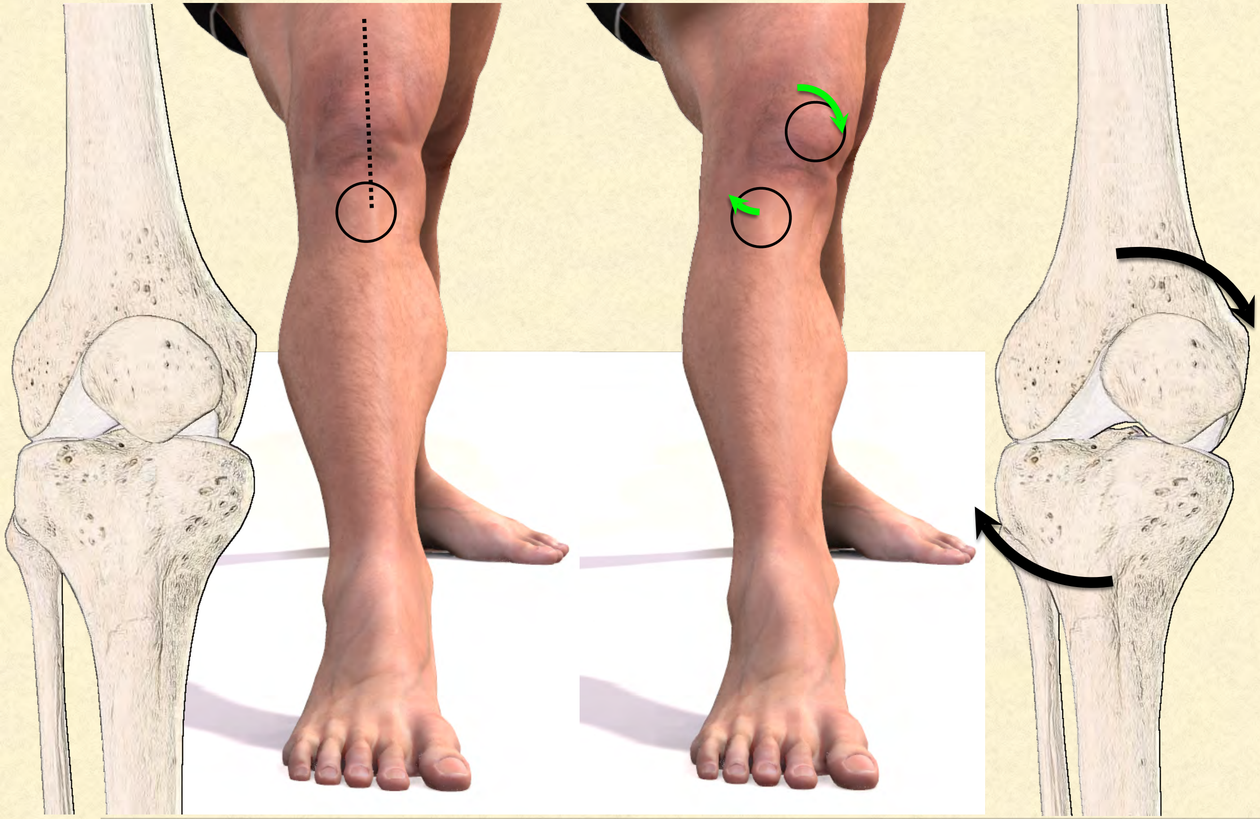
The habit of grabbing onto the toes or feet in Baddhakonasana and pulling on them — causes ***internal*** rotation of the shins — and can be <u>HARMFUL</u> to the knees.



The Result of this Structure:

The Built-in Problem of Rotation:

Tibial Torsion

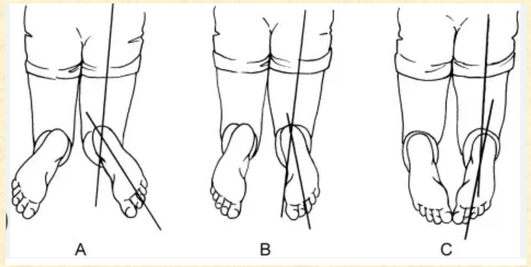


Observing Tibial Torsion When the Leg Straightens:

- The **Thigh Rotates Inward**, Turning the Kneecap Inward Along With It
- The **Top of the Tibia** Will **Rotate Outward**

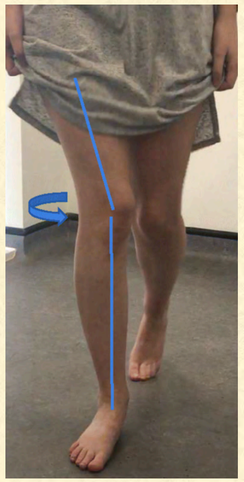
The Two Bones Turning in **Opposite Directions** Is a **Torsion** (Twisting With Pressure) in the Knee Joint.

Tibial Torsion Can Be Structural

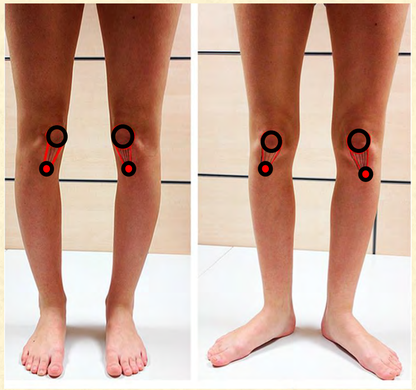


External Normal Internal

This example of tibial torsion is ***structural,*** because of the shape of the tibia.



External tibial torsion is observable in cases in which the knees face forward while the feet are rotated out..



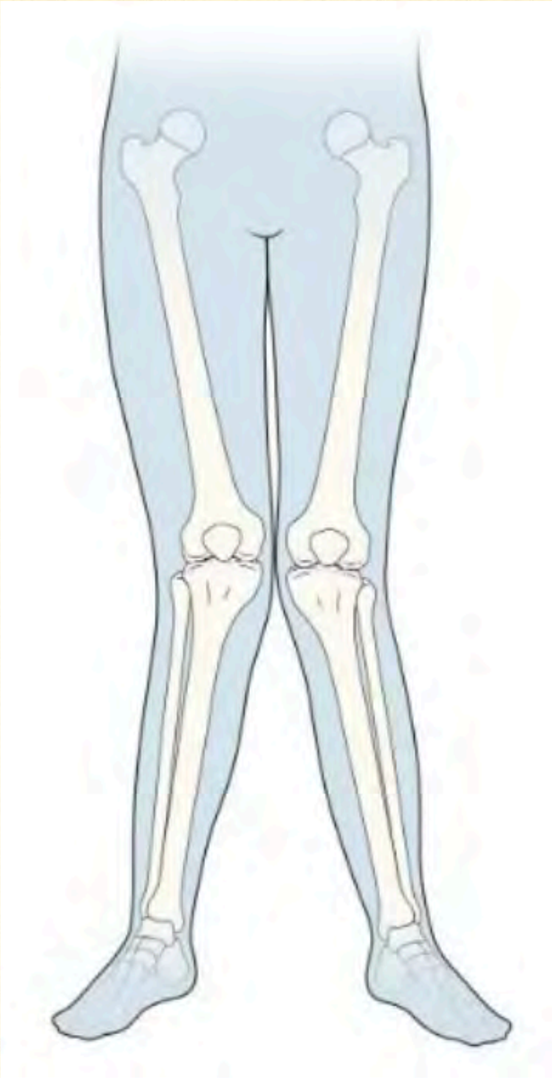
Everyone starts with the tibia rotated inward: as babies we were 'pigeon-toed' (feet turning inward) because the shape of the tibia is internally rotated.

- As a child begins to walk, the tibia is reshaped into a more external rotation, until the feet and knees face straight forward.

This natural development of external rotation of the tibia can in ***<u>some</u>*** cases progress **too far**.

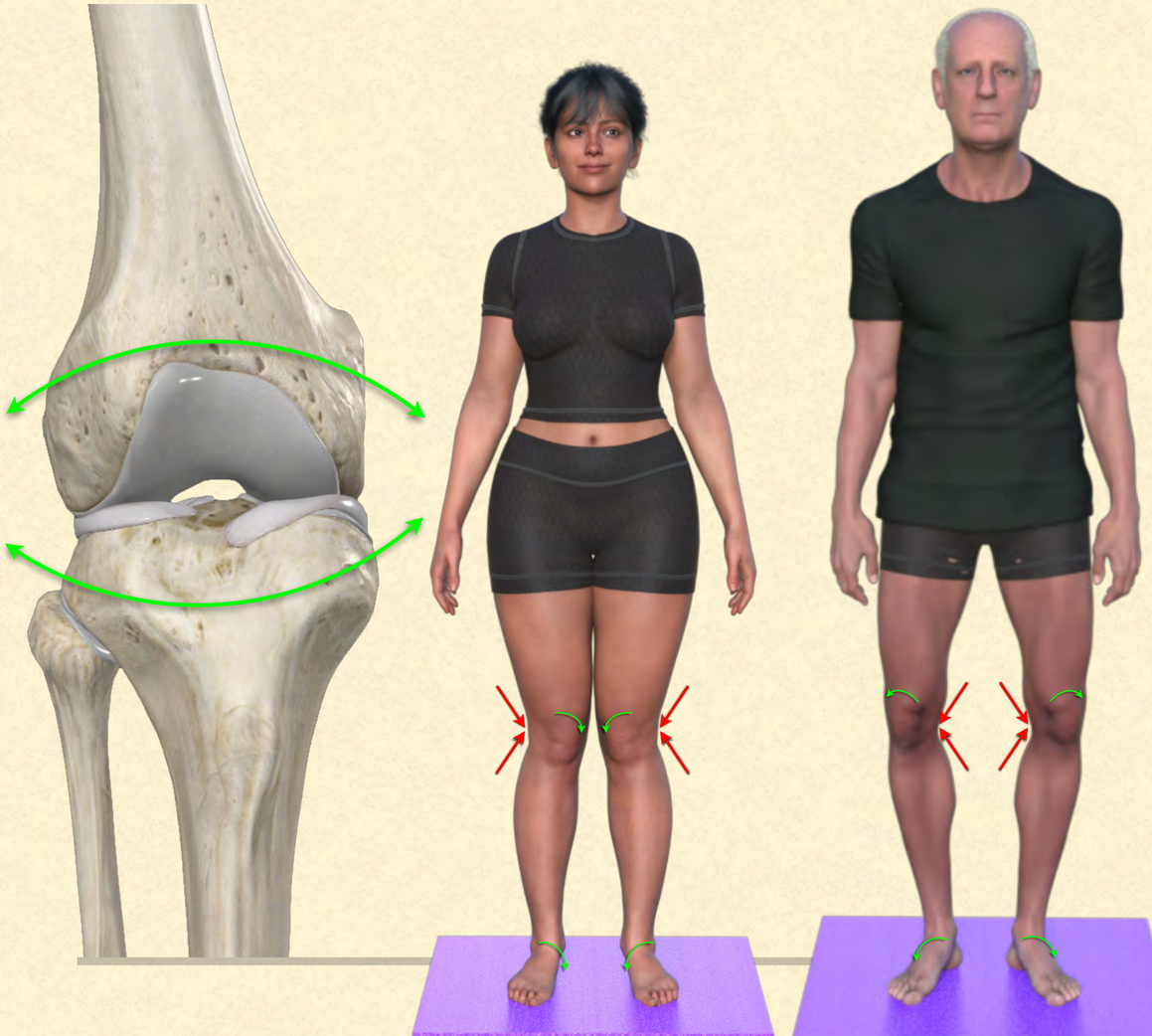
This creates a strong twisting or tibial torsion inside the knee if you try to force your feet to be parallel:

- In that case, the ***thighs*** will rotate ***inward***, making the kneecaps 'squint' inward, while the top of the ***shins*** will still be rotated ***outward*** relative to the kneecap.



Side-Tilt

Reduced Joint Play in Side-Tilts: X-Legs and O-Legs

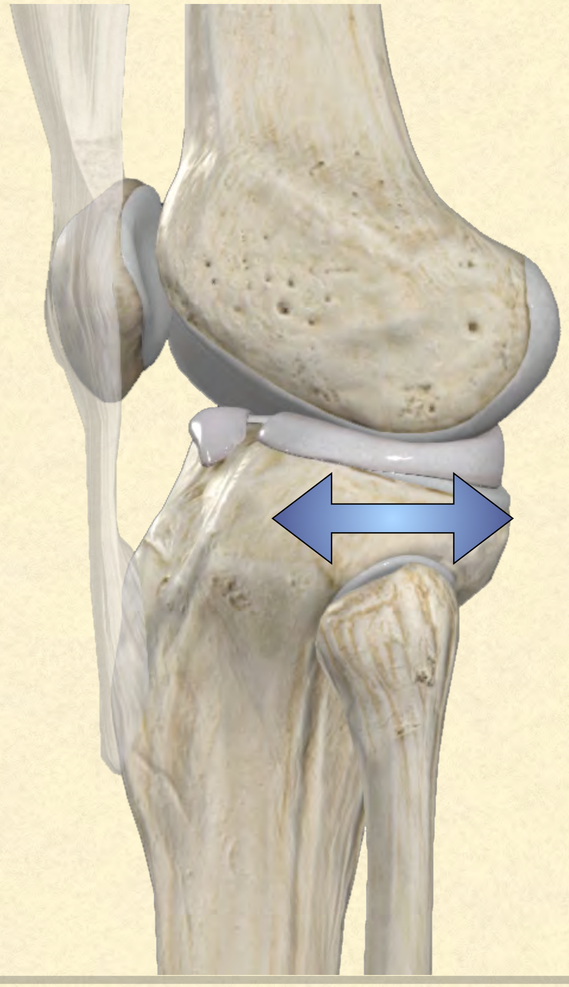


Postural shapes, whether structural or functional, can 'lock' us into one side-tilt or the other — whether in cases of 'X'-legs (Knock-knees) or 'O'-legs (Bow legs)

Actions of abduction or adduction can put ***stress*** on the knees when they are locked into a lateral tilt by having the legs straight.

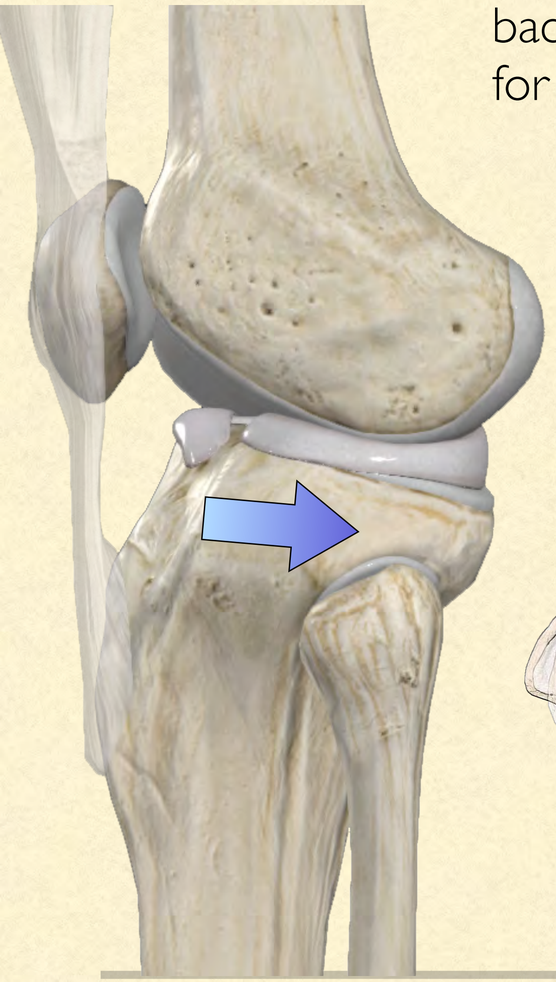
The knees need to be slightly bent during abduction or adduction, **to allow sufficient joint play,** to realign the knees!

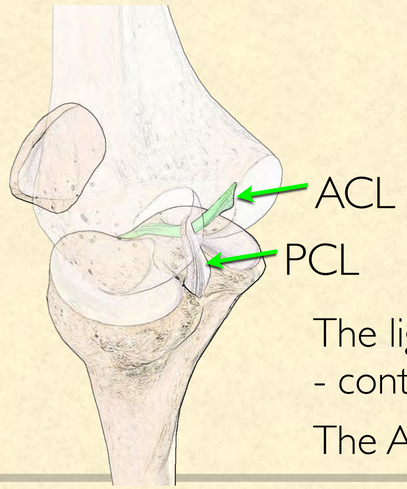
Slide
And Hyperextension

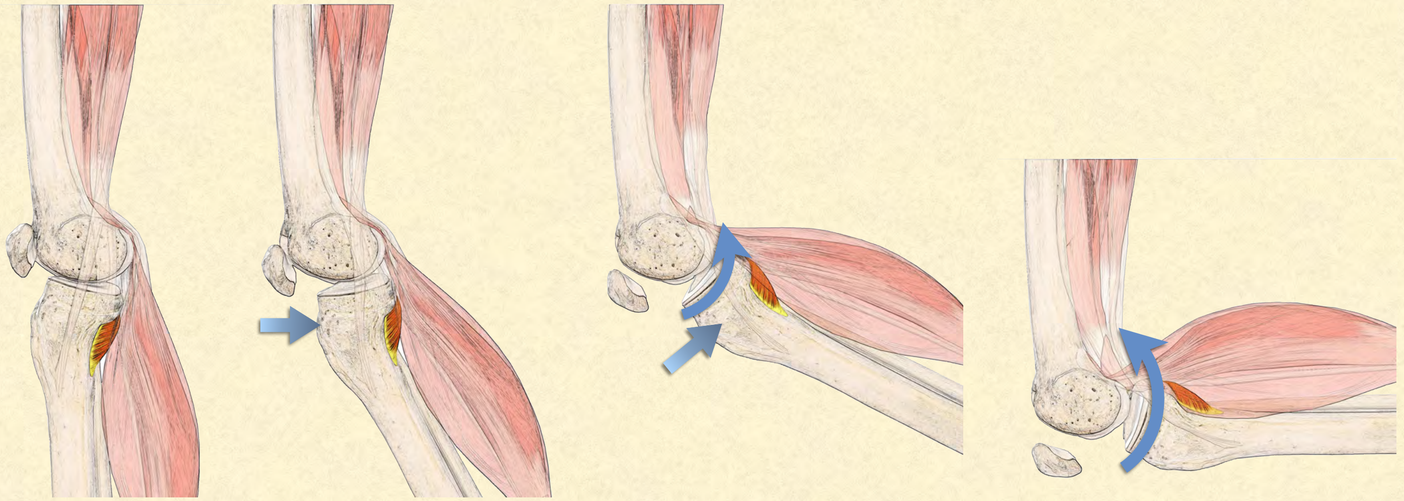


Joint Play in Forward and Backward Slides

The tibia ***must*** be able to slide backward on the femur in order for the knee to bend!







The ligaments that control the anterior-posterior slide are the Anterior Cruciate Ligament (ACL - controls forward slide) and Posterior Cruciate Ligament (PCL - controls backward slide).

The ACL is more commonly injured - from trauma or hyperextension

Better Joint Play Through Virabhadrasana 2

What's 'wrong' with the knee going beyond 90° when weight-bearing? It **reduces proper joint play** of the femur and tibia while straining the patellar tendon.

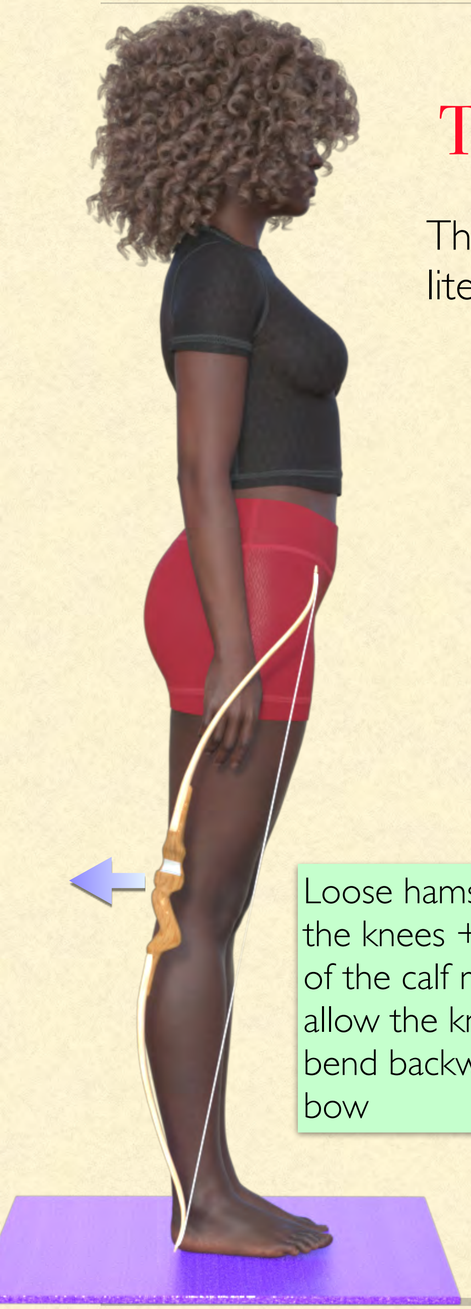
the **femur cannot slide forward properly on the tibia,** and the **tibia is pulled forward**, straining the patellar tendon and putting added pressure on the kneecap.

— ***and*** **the hip is unable to bend fully**, from tension in the quadriceps at the knee.

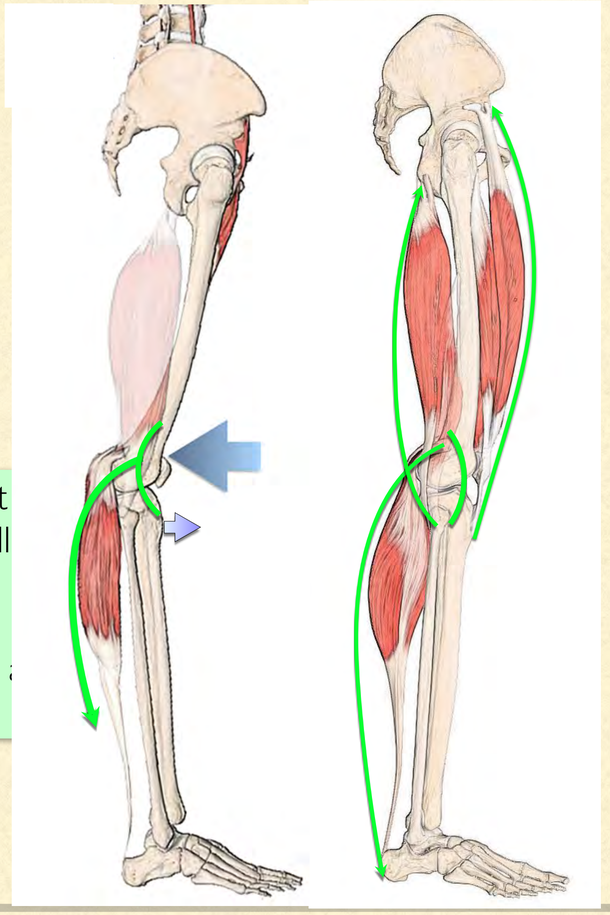
The ***correct*** **alignment** of the lower leg in Warrior 2 is meant to support and ***promote*** **better joint play** or 'sliding' of the femur forward on the tibia as the tibia slides back.

The Knees: Hyperextension

The technical term for hyperextension literally means 'the knee bending backwards!



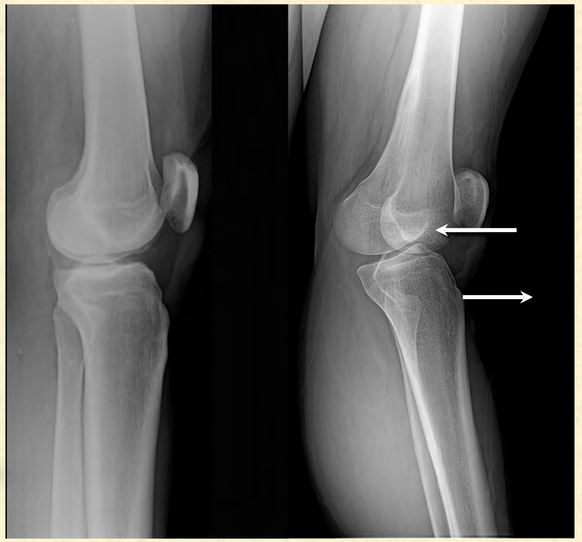
Loose hamstrings at the knees + the pull of the calf muscles allow the knees to bend backward like a bow



Hyperextended Normal

A stable and well-aligned knee in a static posture has a slight '***forward***' bend (flexion), which is maintained by opposing muscles crossing over the knee joint.

The pull of these opposing muscles maintains joint play and keeps the bones aligned.



Normal Hyperextended

The Hamstrings at the Inner Knee

The hamstring tendons at the back of the knee are weakened with hyperextension, and this has consequences for the knee joint.

The '***inner***' hamstrings are designed to ***resist*** hyperextension, and to keep the femur and tibia aligned for good knee tracking.

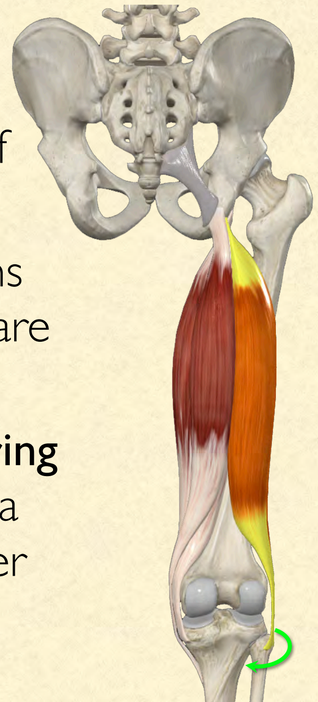
If the inner hamstring is weak or not engaged,

- the head of the **calf muscle** pulls the **inner knee** into greater **hyperextension**
- And the **femur** **rotates** **inward** relative to the tibia, creating further twisting or torsion of the knee joint.

The 'outer' hamstrings also contribute to the twisting of the knee:

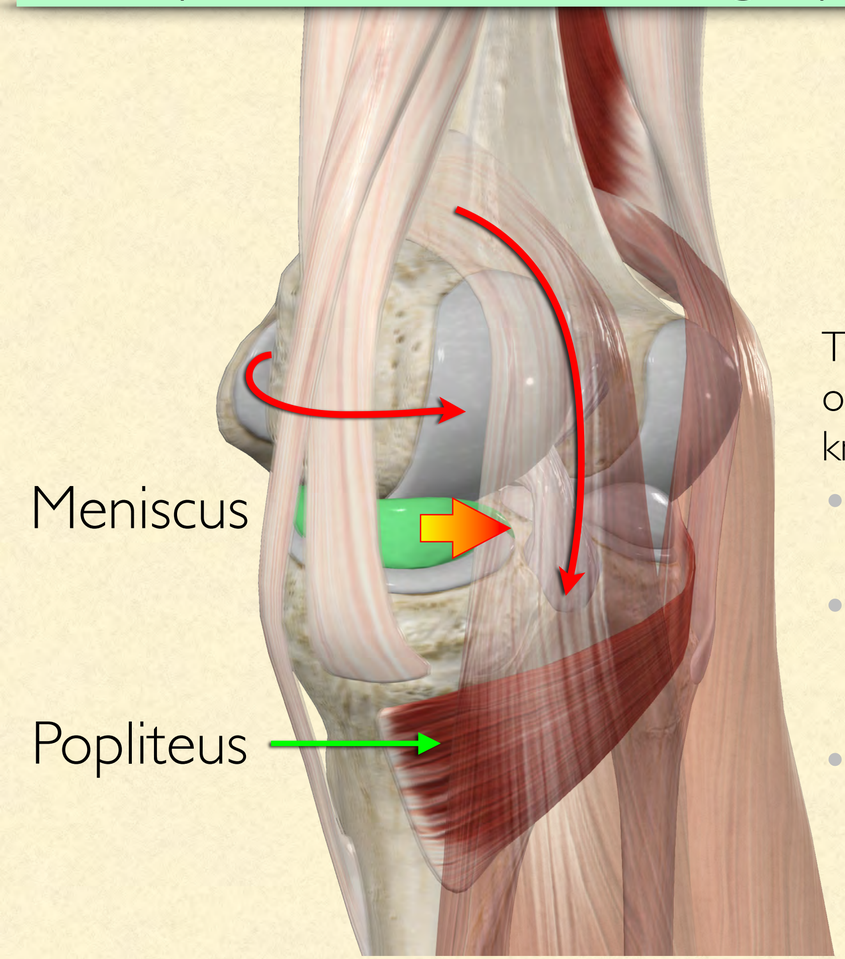
The outer hamstring tightens when the inner hamstrings are weak,

And the **tight outer hamstring** ***rotates*** the **lower** leg — tibia and fibula — ***outward***, further **twisting the knee**.



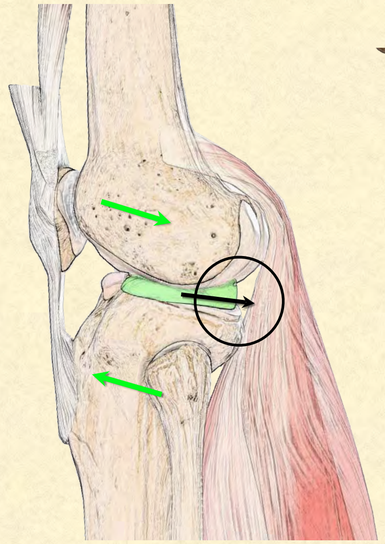
The Popliteal Cyst / Baker's Cyst

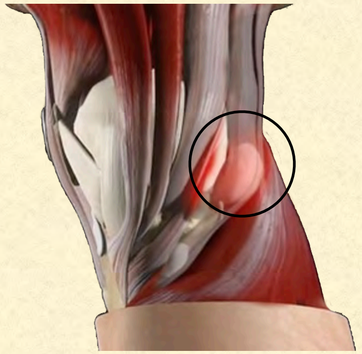
Hamstring stretches with tight calves, combined with locked knees / tibial torsion at the inner knees put us at risk of forming a popliteal cyst.



These pressures on the knee can cause the formation of a popliteal cyst or 'Baker's Cyst' at the back of the knee.

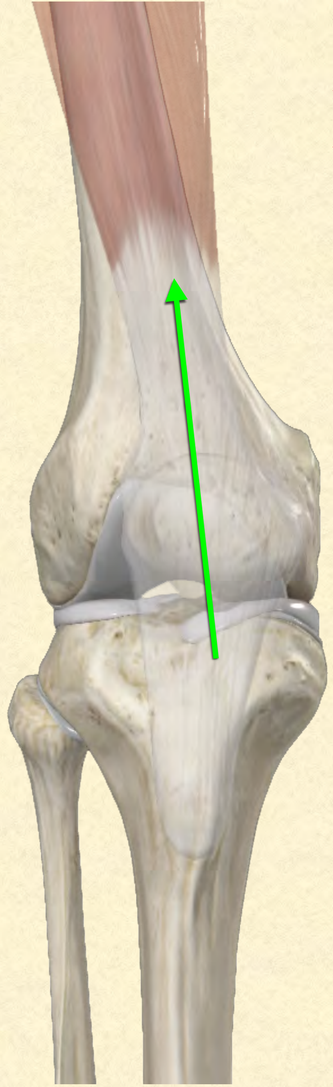
- The **popliteus** is designed to ***counter*** the torsion of the femur and tibia.
- But when it is ***weak***, and the pull of a tight calf is strong, the meniscus gets squeezed into the space at the back of the knee.
- This can cause either **swelling** or a **cyst** at the back of the knee that appears when the leg is straightened.





Popliteal Cyst / 'Baker's Cyst

The problem of a weak popliteus shows up as pain at the inner knee, and puffiness or instability at the back of the knee

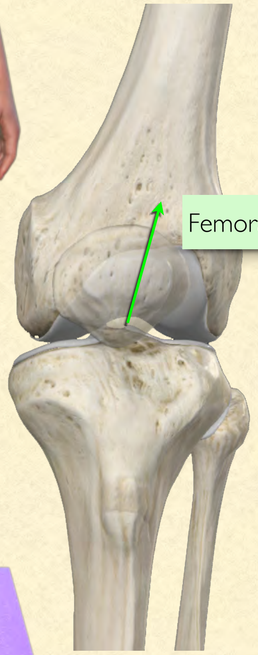


Knee Pain From Improper Tracking of the Kneecap

Ideally the kneecap slides in the center of the femoral groove from the pull of the quadriceps through the patellar tendon

And yet from a weakening of the inner knee, the kneecap can slide laterally, rubbing up against the outer edge of the femoral groove, where there is less cartilage and more nerve endings, registering pain.

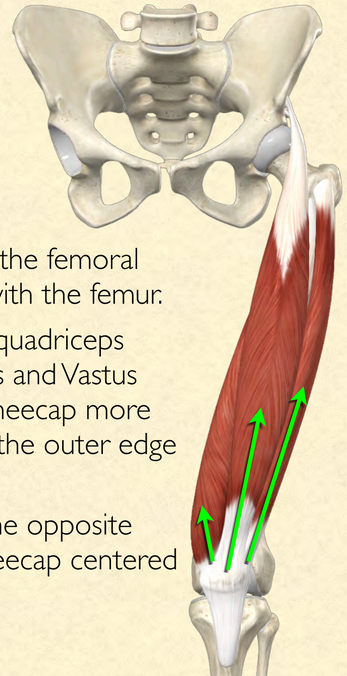
- When this friction wears down and damages the cartilage, this is called **chrondromalacia**;
- when there is ***pain*** in the knee ***without*** cartilage damage, it is the **patellofemoral pain syndrome**



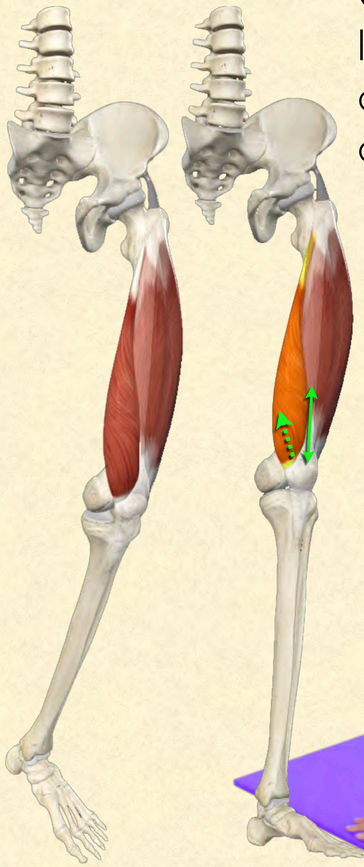
Because of the Q Angle, the femoral groove is angled in line with the femur.

And the majority of the quadriceps muscles - Rectus Femoris and Vastus Lateralis - also pull the kneecap more strongly laterally, toward the outer edge of the femoral groove.

Vastus Medialis pulls in the opposite direction to keep the kneecap centered in the femoral groove.



Engaging Vastus Medialis – Leg Extension



Once you've located the muscle, straighten your leg, gradually straighten your leg, concentrating on the feeling of your thigh muscle firming and drawing your kneecap upward.

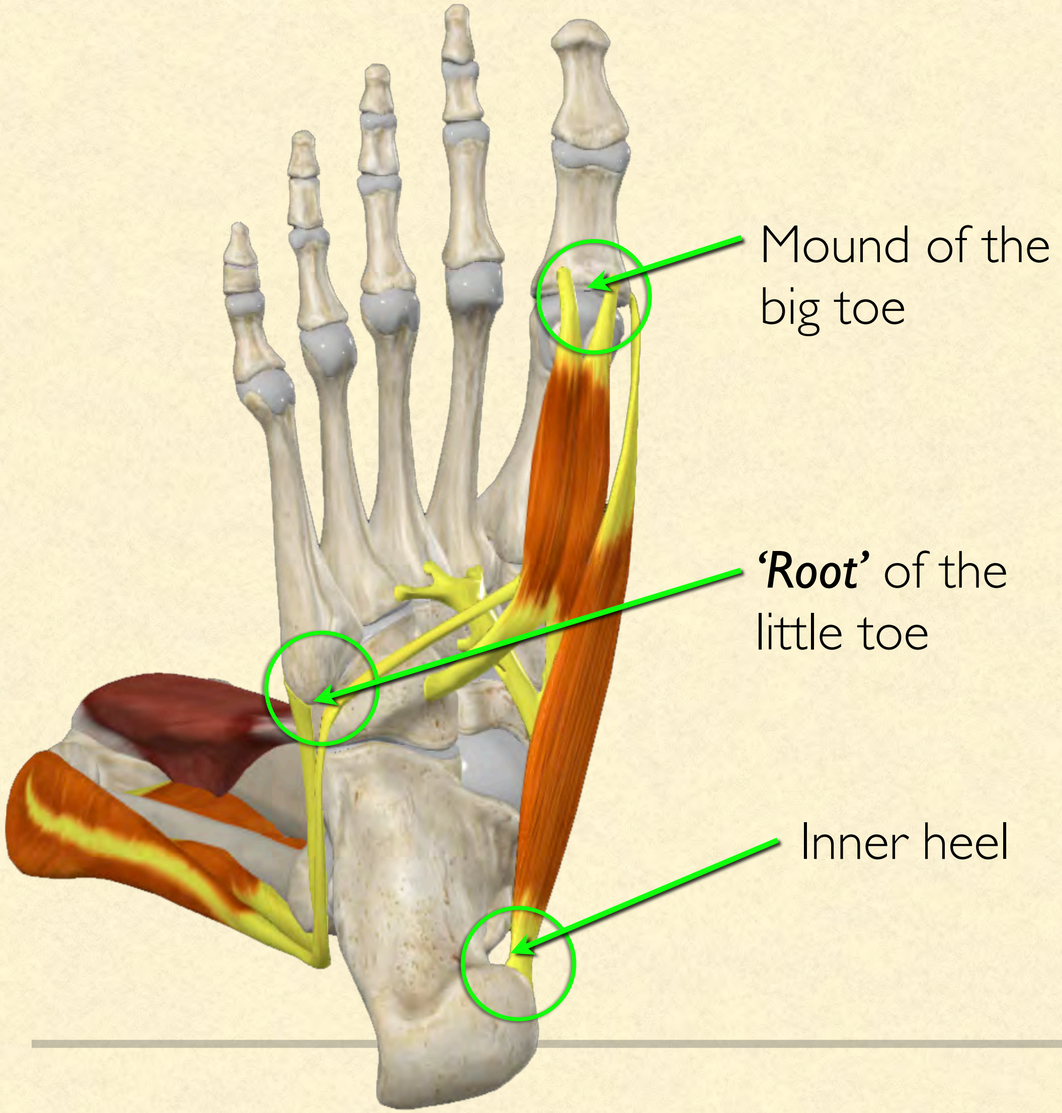
Press forward through the mound of your big toe, spiraling your lower leg inward slightly, to help you intensify the firming of of Vastus Medialis.

It's also helpful to press the back of your leg, just above the knee, into the blanket as you extend your leg.

As the leg becomes fully straight — in the last 10° - 20° of the extension — you'll feel vastus medialis contract and harden. **See that the kneecap moves in a straight line along the center of the knee joint**, rather than pulling out to the side.

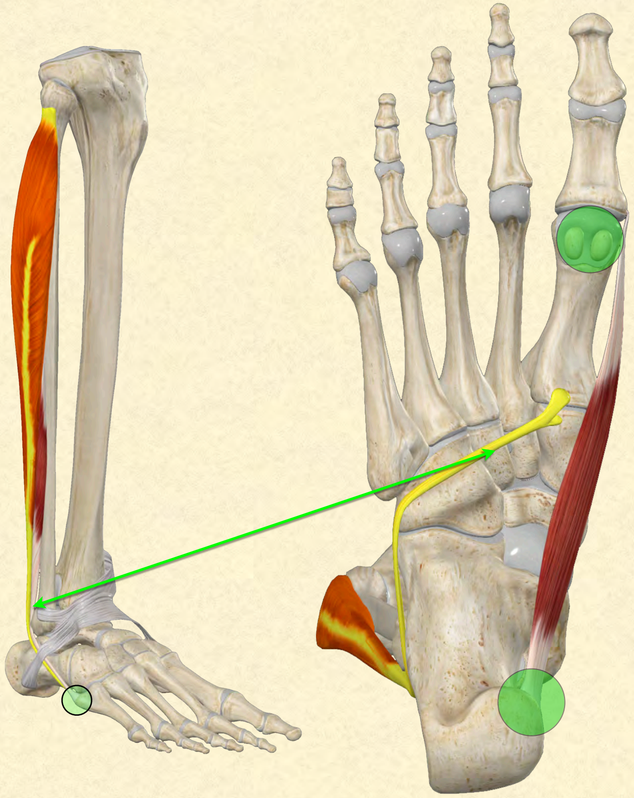
Once you've found the muscle, contract and hold it firm for 8-10 seconds. Concentrate on 'making the leg longer' through the mound of the big toe, rather than locking the knee. You can do this exercise several times a day; just be careful not to fatigue the muscle by doing too many sets at a time.

A Key to the Knees: the Feet



Primary Actions

1. 'Stepping on the Gas'



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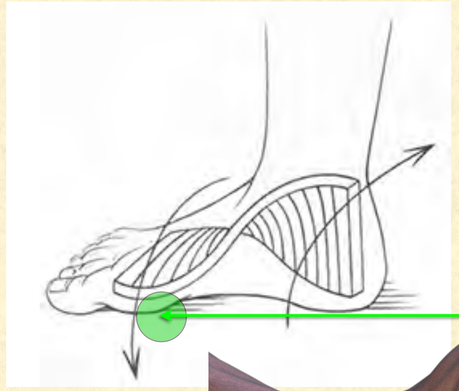
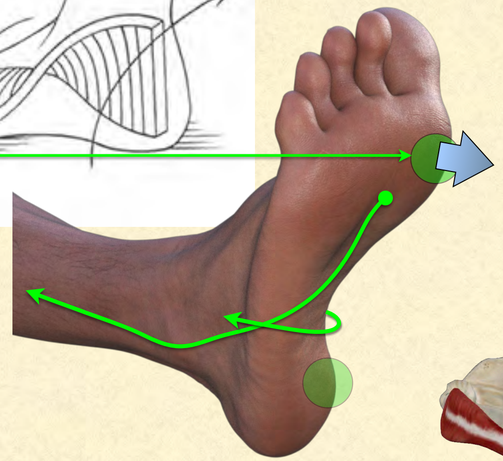
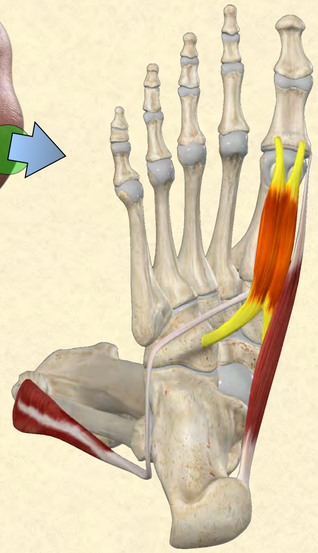




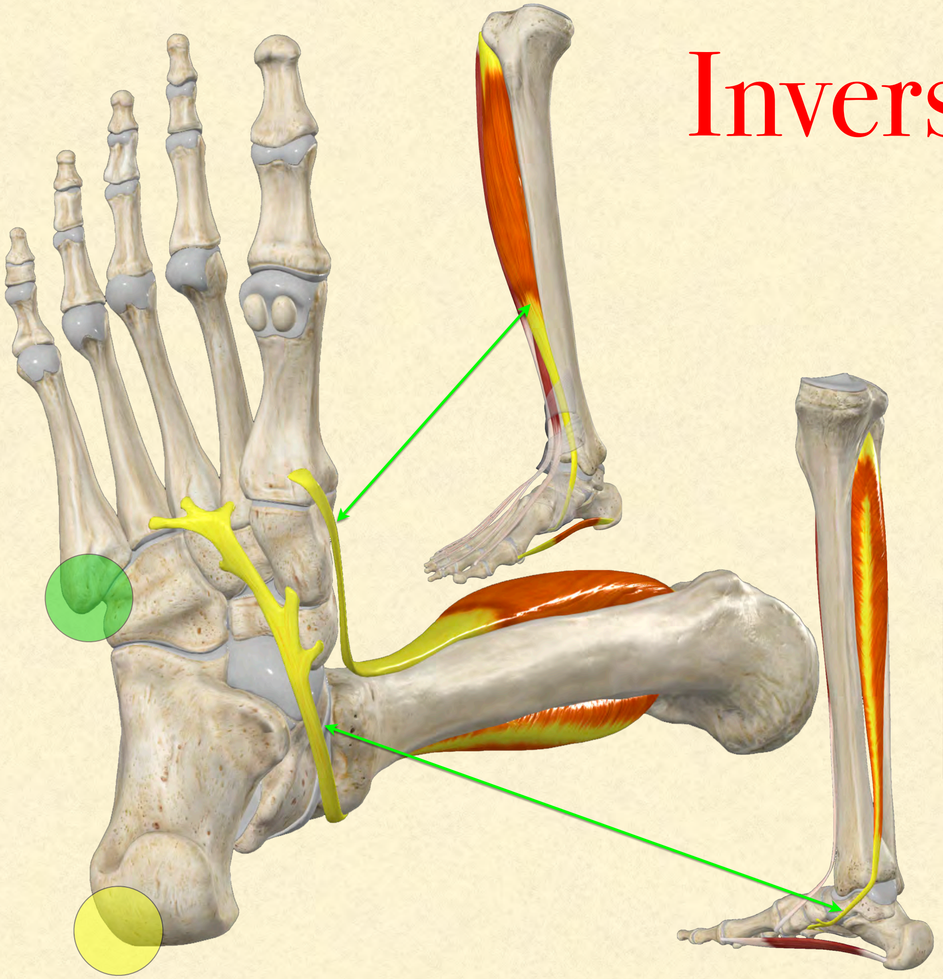


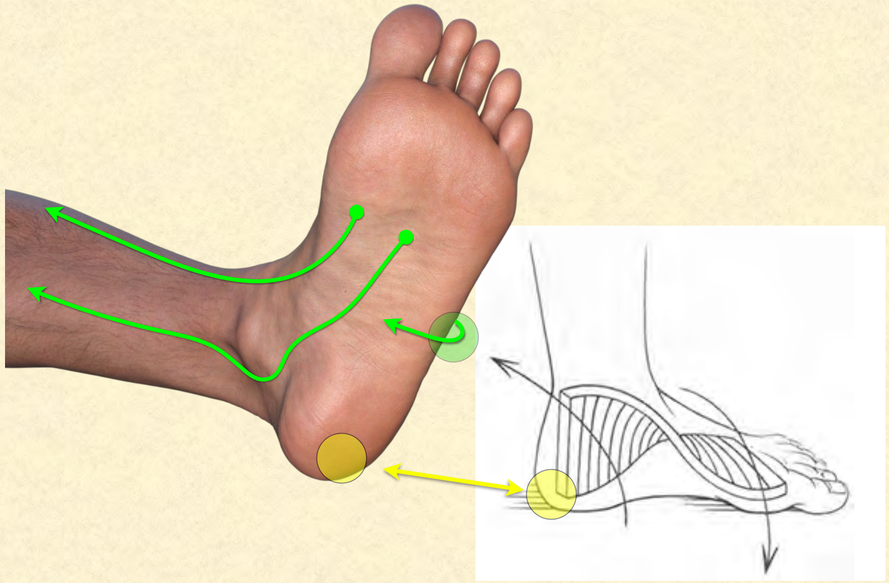
When the big toe is lifted (or when you lift your heel), flexor hallucis brevis helps you to ***press*** through the mound of your big toe, 'stepping on the gas;' otherwise you use it to flex your big toe.

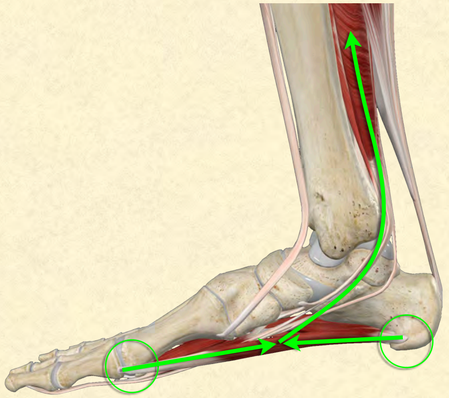
Otherwise known as 'flointing' the foot

2. 'Opening the Book'

Inversion







Inversion of the foot also uses Tibialis Posterior, which assists the lift of the arch, and activates the connection between inner heel and big toe, supporting the arch.