بہت اشک لیں صدیري لیو کیے بیع پر آمری لیو

و احتلال عقیدتہ قی میں لسانی لیو یفقهوا قویلی

پی وار دگار، میر اسید کو حل دیے، اور میرے کلام کو میرے لیے آسان کردے اور میرے اپنی تعلیم کی گھرہ سمجھادے تاکہ لوگ میری

بات کہ جن کیلئی

آیت نبی (ص) 25-28
The Biomechanics of the Human Lower Extremity

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Hip joint

- One of the largest and most stable joint:
  The hip joint

- Rigid ball-and-socket configuration
  (Intrinsic stability)
The femoral head

- Femoral head: convex component
- Two-third of a sphere, Cover with cartilage
- Rydell (1965) suggested: most load------ superior quadrant
- Femur Long, strong & most weight bearing bone.
  - But most weakest structure of it is its neck.
- During walk in single leg support move medially to support C0G. This results in the leg being shortened on non-weight bearing side.
- Fracture of femur-neck common as bone tissue in the neck of the femur is softer than normal.
Acetabulum

- Concave component of *ball and socket joint*
- Facing obliquely forward, outward and downward
- Covered with *articular cartilage*
- Provide static stability
Labrum: a flat rim of fibrocartilage

- Acetabular labrum

  - The entire periphery of the acetabulum is rimmed by a ring of wedge-shaped fibrocartilage called the acetabular labrum

  - Deepens the socket, increases the concavity of the acetabulum, grasping the head of the femur to maintain contact with the acetabulum

  - It enhances joint stability by acting as a seal to maintain negative intra-articular pressure

  - Also provide proprioceptive feedback
Acetabulum

- Also contain Transverse acetabular ligament
- provide stability
Ligaments and Bursae

• **Iliofemoral ligament:** Y shaped extremely strong = anterior stability

• **Pubofemoral ligament:** anterior stability
• **Ischiofemoral ligament:** posterior stability

• **Ligamentum teres** supplies a direct attachment from rim of acetabulum to head of femur
Iliopsoas burs b/w illiopsoas & capsule
Iliopsas Bursitis Pain Pattern
Trochanteric bursitis
The femoral neck

- Frontal plane (the neck-to-shaft angle/angle of inclination),

- Transverse plane (the angle of anteversion)
- Neck-to-shaft angle: 125°, vary from 110° to 135-140°
- Effect: lever arms

The normal neck-to-shaft angle (angle of inclination of the femoral neck to the shaft in the frontal plane) is approximately 125°. The condition in which this angle is less than 125° is called coxa vara. If the angle is greater than 125°, the condition is called coxa valga.
1. ANGLE IF INCLINATION OF FEMUR

- The angle of inclination of the femur approximates 125°

- Normal range from 110° to 144° in the unimpaired adult

- With a normal angle of inclination, the greater trochanter lies at the level of the center of the femoral head

- A pathological increase in the medial angulation between the neck and shaft is called coxa valga

- A pathological decrease is called coxa vara
COXA VARA

- In adolescence, growth of the bone results in a more oblique orientation of the epiphyseal plate.

- The epiphyseal obliquity makes the plate more vulnerable to shear forces at a time when the plate is already weakened by the rapid growth that occurs during this period of life.

COXA VALGA

- Coxa valga also decreases the amount of femoral articular surface in contact with the dome of the acetabulum.

- As the femoral head points more superiorly, there is a decreasing amount of coverage from the acetabulum superiorly.

- Consequently, decreases the stability of the hip and predisposes the hip to dislocation.

- The resulting need for additional abductor muscle force may predispose the joint to arthrosis or may functionally weaken the joint, producing energy-consuming and wearing gait deviations.
Axis of lower limb

- Mechanical axis line passes between center of hip joint and center of ankle joint.

- Anatomic axis line is between tip of greater trochanter to center of knee joint.

- Angle formed between these two is around $70^\circ$
- **Angle of anteversion**: 12º

- **Effect**: during gait
  - >12º: internal rotation
  - <12º: external rotation
The anteverted femur effect the biomechanics of not only hip joint but also disturbed the knee and ankle joint normal mechanics during different physical activities.

- When the femoral head is anteverted, pressure from the anterior capsuloligamentous structures and the anterior musculature may push the femoral head back into the acetabulum, causing the entire femur to rotate medially.

- The knee joint axis through the femoral condyles is now turned medially.

- Medial rotation of the femoral condyles alters the plane of knee flexion/extension and results, at least initially, in a toe-in gait and a compensatory lateral tibial torsion develop.
Biomechanics

- Forces acting across hip joint
  - Body weight
  - Abductor muscles force
  - Joint reaction force

Figure 35.2 Load on the hip joint when subject (weighing W) stands on one leg. Hopping increases the load from 4 to 10W.
Joint reaction force

- defined as force *generated within a joint* in response to forces acting on the joint

- in the hip, it is the result of the need to **balance** the moment arms of the body weight and abductor tension

- maintains a **level pelvis**

- Joint reaction force
  - 2W during SLR
  - 3W in single leg stance
  - 5W in walking
  - 10W while running
Normal hip

- Joint reaction force (JRF) calculation

\[
\text{JRF} (\uparrow) = \text{Body Weight} (\downarrow) + \text{Abductor Force} (\downarrow)
\]

JRF is always higher than the body weight
پریشان حال کی مدو
حقیقت اس حالت کے کچھ ہی واقعات کے نتیجے میں کوئی اثر ممکن ہے کہ اس ہے کہ اس کے نتیجے میں کوئی اثر ممکن ہے۔

Den-E-Islam
The pelvic girdle includes the two ilia and the sacrum. It can be rotated forward, backward, and laterally to optimize positioning of the hip.
MOTION OF PELVIS ON THE FEMUR

- Whenever the hip joint is weight-bearing, the femur is relatively fixed, and motion of the hip joint is produced by movement of the pelvis on the femur.
Anterior and Posterior Pelvic Tilt

- Anterior and posterior pelvic tilts are motions of the entire pelvic ring in the sagittal plane around a coronal axis.

- In the normally aligned pelvis, the anterior superior iliac spines (ASISs) of the pelvis lie on a horizontal line with the posterior superior iliac spines and on a vertical line with the symphysis pubis.

- Anterior and posterior tilting of the pelvis on the fixed femur produce hip flexion and extension.
- Hip joint extension through posterior tilting of the pelvis
- Hip flexion through anterior tilting of the pelvis

Figure 10-20  Flexion and extension of the hip occurring as tilting of the pelvis in the sagittal plane. A. The pelvis is shown in its normal position in erect stance. B. Posterior tilting of the pelvis moves the symphysis pubis superiorly on the fixed femur. The hip joint extends. C. In anterior tilting, the anterior superior iliac spines move inferiorly on the fixed femur. The hip joint flexes.
Lateral Pelvic Tilt

- Lateral pelvic tilt is a frontal plane motion of the entire pelvis around an anteroposterior axis.

- In the normally aligned pelvis, a line through the anterior superior iliac spines is horizontal.

- In lateral tilt of the pelvis in unilateral stance, one hip joint (e.g., the left hip joint) is the pivot point or axis for motion of the opposite side of the pelvis (e.g., the right side) as that side of the pelvis elevates (pelvic hike) or drops (pelvic drop).
- If a person stands on the left limb and hikes the pelvis, the left hip joint is being abducted because the medial angle between the femur and a line through the anterior superior iliac spines increases.

- If a person stands on the left leg and drops the pelvis, the left hip joint will adduct because the medial angle formed by the femur and a line through the anterior superior iliac spines will decrease.

Figure 10–21  Lateral tilting of the pelvis around the left can occur either as hip hiking (elevation of the opposite side of the pelvis) or as pelvic drop (drop of the opposite side of the pelvis). A. Hiking of the pelvis around the left hip joint results in left hip abduction. B. Dropping of the pelvis around the left hip joint results in left hip joint adduction. Although it is visually tempting to name the direction of lateral tilt by the motion of the side of the pelvis nearest the hip (gray arrows that are “crossed out”), this is incorrect.
Lateral Shift of the Pelvis

- With **pelvic shift**, the pelvis cannot hike; it can only drop.

- Because there is a closed chain between the two weight-bearing feet and the pelvis, both hip joints will move in the frontal plane in a predictable way as the pelvic tilt (or pelvic shift) occurs.
• Forward (anterior) rotation of the pelvis occurs in unilateral stance when the side of the pelvis opposite to the weight-bearing hip joint moves anteriorly from the neutral position.

• Forward rotation of the pelvis produces medial rotation of the weight-bearing hip joint.
• Backward (posterior) rotation of the pelvis occurs when the side of the pelvis opposite the weight-bearing hip moves posteriorly.

• Backward rotation of the pelvis produces lateral rotation of the supporting hip joint.

Figure 10-23  A superior view of rotation of the pelvis in the transverse plane. A. Forward rotation of the pelvis around the right hip joint results in medial rotation of the right hip joint. B. Neutral position of the pelvis and the right hip joint. C. Backward rotation of the pelvis around the right hip joint results in lateral rotation of the right hip joint. The reference for forward and backward rotation is the side opposite the supporting hip, although the eye often erroneously catches the opposite motion of the pelvis on the same side (gray crossed-out arrows).
Kinematics

- Rang of motion in all three planes: sagittal, frontal, transverse

- Flexion: 0° to 140°
- Extension: 0° to 15°
- Abduction: 0° to 30°
- Adduction: 0° to 25°
- External rotation: 0° to 90°
- Internal rotation: 0° to 70°
**Movements at the Hip**

Movements of the femur are facilitated by pelvic tilt.

<table>
<thead>
<tr>
<th>Pelvic tilt direction</th>
<th>Femoral movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>posterior</td>
<td>flexion</td>
</tr>
<tr>
<td>anterior</td>
<td>extension</td>
</tr>
<tr>
<td>lateral (to opposite side)</td>
<td>abduction</td>
</tr>
</tbody>
</table>
Movements at the Hip

What muscles contribute to **flexion** at the hip?

- iliacus
- Psoas Major
- Assisted by:
  - Pectineus
  - Rectus femoris
  - Sartorius
  - Tensor fascia latae
 Movements at the Hip

**extension** at the hip joint?

• Gluteus maximus
• Hamstrings
  • Biceps Femoris
  • Semimembranosus
  • Semitendinosus
Movements at the Hip

abduction at the hip joint

• gluteus medius
• assisted by:
  • gulteus minimus
Movements at the Hip

**adduction** at the hip joint?

- adductor magnus
- adductor longus
- adductor brevis
- assisted by:
  - gracilis
Movements at the Hip

**lateral rotation** at the hip joint?

- Piriformis
- Gemellus superior
- Gemellus inferior
- Obturator internus
- Obturator externus
- Quadratus femoris
Movements at the Hip

**medial rotation** at the hip joint?

- gluteus minimus
- Assisted by:
  - TFL
  - Semimembranosus
  - Semitendinosus
  - Gluteus medius
رب انشکی لی صدیقی ۵ و کبیری لی آمعری ۶
و احیال عقیدتین فین لسانی ۷ لیفقهوا قوئی ۸

پر دوگار میرا سید كہول دے، اور میرے کا کام کو میرے لیے
آسان کر دے اور میری زبان کی سگی سمجھنے دے تاک کہ لوگ میرے
پات کہنی سکیں.
LOADS ON THE HIP

- Highly specialized and well designed
- Compressive forces due to following:
  1. Amount of load (more than ½ of body weight above hip + tension in surrounding muscles).
  2. Effect of speed → increase speed increase load, Footwear also effect load.
  3. Load decrease due to smooth gait pattern & soft heel strike...
  4. Training surface plane v/s slop surface
  5. Painful conditions of lower limb increase loading on hip joint
A woman’s body will attempt to compensate for the off-kilter balance heels cause by flexing or forward bending the hips and spine. In order to maintain balance, the calf, hip, and back muscles become tense. At the end of the day, this makes for excess muscle fatigue and strain. Over time, wearing high heels can also cause the calf muscles to cramp and bulge.\(^{[2,1]}\)
COMMON INJURIES OF THE HIP

Fractures

• Hip is subjected to high repetitive loads---4-7 times the body weight during locomotion

• **Fractures of femoral neck** common due to (aging, osteoporosis)

• Loss of balance and fall fracture (Fall fracture: serious issue & death increasing 5-8 fold during 1\(^{st}\) three month of fracture.)

• **Treatment:**
  • Regular physical activity
Osteoporosis

Healthy bone  

Osteoporosis
Injuries contd...

CONTUSIONS

• Anterior aspect muscles—prime location for direct injury in Contact sports—Internal hemorrhaging—
  → Appearance of bruises mild to severe
   Uncommon but serious complication as compartment syndrome
   in which internal hemorrhage—
    → compression on nerves, vessels, muscle—tissue death
Injuries contd...

**STRAINS**

- **Hamstring strain**……late stance or late swing phase as eccentric contraction. (simultaneous hip flexion & knee extension)
- **Groin Strain**….forceful thigh movement in abduction causes strain in adductors (ice hockey players)
حضرت عمر فاروق رضي الله تعالى عن

جس نرب کے لیے جھکنا سیہلیاں ہیں علم والا ہے
کیونکے علم کی پہچان عاجزی ہے اور جائزی کی پہچان سکھری ہے
KNEE BIOMECHANICS
Structure of the Knee

Modified hinge joint. Formed by Tibofemoral & patello femoral joint.

Tibiofemoral joint?

- **Dual** condyloid articulations between medial and lateral condyles of tibia and the femur; composing the main hinge joint of the knee.
Femur

- Medial and lateral condyles
  - Convex, asymmetric
  - Medial larger than lateral
Tibia

- Medial tibial condyle: concave
- Lateral tibial condyle: flat or concave
- Medial 50% larger than lateral
Structure of the Knee

Bony structure of the tibiofemoral joint.
Structure of the Knee

What is the patellofemoral joint?

- articulation between the patella and the femur
- (the patella improves the mechanical advantage of the knee extensors by as much as 50%)
- Close pack position= full extension
Patellofemoral joint motion

- Gliding movements = 7 cm in vertical direction
- Superior glide
- Inferior glide
- Lateral and medial shifting (v. little)
Structure of the Knee

- The menisci of the knee. Medial meniscus is also attached directly to the medial collateral ligament.
• The menisci of the knee.
• Deepens the articulating depression of tibial plateaus
• Load transmission and shock absorption
• Without menisci the weight of the femur would be concentrated to one point on the tibia and stress may reach up to 3 times
• Increased likelihood of degenerative conditions
Ligaments
Medial & lateral stabilizers

Most important static & dynamic stabilizers by ligaments & muscles

- tensile strength - related to composition of muscle
- **Primary valgas restraint**
  - -57-78% restraining moment of knee (MCL), Tense in lateral rotation of tibia, lax in flexion
Lateral side

- LCL
- Primary Varus restraint
- lax in extension
- Taut in medial rot
Cruciates

- **ACL**
  - Primary static restraint to anterior displacement
  - Tense in extension, 'lax' in flexion

- **PCL**
  - Primary restraint to posterior displacement - 90%
  - Relaxed in extension, tense in flexion
  - Restraint to Varus/valgus force
  - Resists rotation, esp. int rot of tibia on femur
Other Important Structures

- **Articular cartilage**
  - 1/4 inch thick
  - tough and slick
  - Provide resistance to tensile & compression loading

- **Patella and patellar tendon**
  - Tibial tuberoscocity
  - Patellofemoral groove
  - Patella acts like a fulcrum to increase the force of the quadriceps muscles
Muscles

- Quadriceps - extension
- Hamstrings - flexion
- IT band from the gluteus maximus and tensor fascia latae (hip & knee flexion & hip abduction)
**Screw home – locking mechanism:**

- A key element to knee stability for standing upright, is the rotation between the tibia and femur.
- It occurs at the end of knee extension, between full extension (0 degrees) & 20 degrees of knee flexion.
- The tibia rotates internally (unlock) during the swing phase and externally (lock) during the stance phase.
- External rotation occurs during terminal degrees of knee extension and results in tightening of both cruciate ligaments, which locks the knee.
- The tibia is then in the position of maximal stability with respect to the femur.
- Vice versa by poplitius muscle
- **Open chain:**
  When distal part of joint moves during movement & proximal part of joint remain stationary. (flex, ext etc)

- **Closed chain movements?**
  When proximal part of joint moves during movement & distal part remain stationary. (squat movement, pushups)
**Loads on the knee joint**

**Tibiofemoral joint:**
- Compression loading more in stance phase
- **Shear loading** = tendency of the femur to displace anteriorly on tibial plateaus *(glide)*
- Knee flexion angle exceeding than 90 degree result in larger shear forces.

**To avoid excessive loading:**
- Full squats not recommended for untrained individuals and novice athletes
forces at Patellofemoral joint

- 1/3\textsuperscript{rd} of body weight compressive forces during normal walking
- 3 times the body weight during stair climbing\(\rightarrow\)High compressive forces during knee flexion
- Squatting highly stressful to the knee complex
Common Injuries of the Knee & Lower Leg
Patella Fractures

- Result from direct blow such as knee hitting dashboard in MVA, fall on flexed knee, forceful contraction of quad. Muscle.
- Transverse fractures most common
Femoral Condyle Fractures

These injuries secondary to direct trauma from fall with axial loading or valgus or varus force/blow to distal femur.
Genu valgum & Genu varum
Thank You
نور محروم کی وکیلا

نور محمد سویت

روستا الاسلامی (اللہ علیه وعلوم)-کے ارتعاش، فرمایا: 

آپ یہاں (کی بنا) نیچر برے کے بنا آباؤں نے کسی کے سال اللہ (تعالی) 

ان کے دن تک یہ میرا کہاں ہے؟ کہیں دنوں سے باہر ہے؟ 

(کلم: 865)
Anterior Cruciate Ligament Injury

- ACL one of the major ligaments in your knee can withstand approximately 400 pounds of force
- Common injury particularly in sports (3% of all athletic injuries)
- Anterior cruciate ligament (ACL) injuries occur from both contact and noncontact mechanisms.
- The most common contact mechanism is a blow to the lateral side of the knee resulting in a valgus force to the knee. This mechanism can result in injury not only to the ACL but to the medial collateral ligament (MCL) and the medial meniscus as well.
This injury is termed the “unholy triad” “unhappy triad” injury because of the frequency of these three structures being injured from a common blow.

- A deceleration, hyperextension or internal rotation of tibia on femur & external rotation of femur on Tibia in full weight bearing tears ACL.
Anterior Cruciate Ligament injury

- The most common noncontact mechanism is a rotational mechanism in which the tibia is externally rotated with planted foot when non-wt bearing.
- ACL injuries most commonly occur during sports that involve sudden stops or changes in direction, jumping and landing — such as soccer, basketball, football and downhill skiing.
- May hear “pop”, sound with inflammation at knee joint.
Incidence of ACL injuries is more in females

Notable lessening of extension range of motion at the knee due to quadriceps avoiding (gait)

Weakness in quadriceps, impaired joint range and proprioception

Muscle inhibition: inability to activate all motor units of a muscle during maximal voluntary contraction

Altered joint kinetics == subsequent inset of osteoarthritis

Surgical repair through middle third of patellar tendon
Medial collateral ligament injury

- Isolated injuries to the medial collateral ligament (MCL) can occur from valgus forces being placed across medial joint line of the knee.
- Whereas most injuries to the ACL and PCL are complete tears of the ligament, injuries to the MCL can be partial or incomplete and are graded utilizing a I, II, III grading classification of ligament injuries.
- Contact sports= football= MCL injury more common
- Both MCL and LCL injured in wrestling
Lateral Collateral Ligament Injuries

Lateral collateral ligament (LCL) are infrequent and usually result from a traumatic varus force across the knee.
Posterior Cruciate Ligament

- Less common than ACL injury
- Mechanism is hyperflexion of knee with foot plantarflexed
- PCL sprains usually occur because the ligament was pulled or stretched too far due to anterior force to the knee, or a simple misstep.
PCL Injuries

- Impact with dash board during motor vehicle accident
- Direct force on proximal anterior tibia
- PCL injuries disrupt knee joint stability because the tibia can sag posteriorly.
- The ends of the femur and tibia rub directly against each other, causing wear and tear to the thin, smooth articular cartilage.
- This abrasion may lead to arthritis in the knee.
Meniscus Injuries

- One of the most commonly injured parts of the knee
- Mechanism is usually squatting or twisting maneuvers with flexed knee. Also, they can occur in combination with other injuries such as a torn ACL (anterior cruciate ligament).
- Older people can injure the meniscus without any trauma as the cartilage weakens and wears thin over time, resulting in degenerative tear.
Meniscal injuries

- Symptoms include pain, catching and buckling
- Signs include tenderness and possible clicking
- There is locking of the knee on flexion or extension that is painful or limits activity.
- Medial meniscus more commonly damaged due to its attachment with the MCL
**Prophylactic**: knee bracing

- To prevent knee ligament injuries in contact sports....use some dynamic support in form of bracing or kinesio tapes.
- Protection from torsional loads
- Reduced sprinting speed and earlier onset of fatigue.
Patellar Tendonitis

- Due to high deceleration or eccentric forces of the quadriceps at the knee during landing.
- At time of landing hamstrings cause your knee to flex to absorb the shock of foot strike to ground.
- In order to control or decelerate; the flexion produced by the hamstrings, the quadriceps muscles contract eccentricly (quad lengthened & stretched).
- **Eccentric** contractions produces **high amounts of force**, and therefore stress to the patellar tendon, repetitive abnormal high stress may cause tendinitis.
Iliotibial band friction syndrome

Friction of posterior edge of Iliotibial band against the lateral condyle of the femur during foot strike

Very common in distance runners, hence referred as runner’s knee

Training errors and anatomical malalignments of tibia, femur or patella.

Excessive tibial lateral torsion, femoral anteversion, genu valgum, genu varum, increased Q angle etc,
Iliotibial Band Friction Syndrome

Tensor Fascia Lata

Iliotibial Tract

Vastus Lateralis

Lateral Epicondyle of Femur

Insertion of iliotibial tract to tibia.

Diagram showing friction of iliotibial tract on lateral femoral epicondyle as the fascial tract glides back and forth.

Area of diffuse pain and tenderness.
بسم اللہ الرحمن الرحیم

جوہر شاہ خواجہ ذیب

"اور ظفرت ائتمان نے دوائیت بہ کھدائے کرم جھیل کے نفرا لابن
کبائی نہیں شیخ ایک فلاک بہت بنا کیا بہ کہ کوئی ایک شخص اپنے
ہر دل کے جوہر ہے میں اپنے شیخ کی ہو جوی

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Q ANGLE

The alignment of the patella in the frontal plane is influenced by the line of pull of the quadriceps muscle group and by its attachment to the tibial tubercle via patellar tendon.

The result of these two forces is a bowstring effect on the patella, causing it to track laterally. One method of describing the bowstring effect is to measure the Q-angle. The Q-angle is the angle formed by two intersecting lines: one from the anterior superior iliac spine to the midpatella, the other from the tibial tubercle through the midpatella.

A normal Q-angle, which tends to be greater in women than men, is 10 to 15 degree.
Q Angle of the Knee

- **Normal**: <15°
- **Knock-kneed**: >20°
- **Bow-legged**: <10°
- Increased Q-angle. The greater the Q angle, the greater the tendency to move patella laterally & Increased pressure at lateral femoral condyle. when the knee flexes during weight bearing.

- A large Q angle plus strong quad contraction can dislocate patella.

- Structurally, an increased Q-angle occurs with a wide pelvis, femoral anteversion, coxa vara, genu valgum, and laterally displaced tibial tuberosity.

- Lower extremity motions in the transverse plane due to increased Q-angle are external tibial rotation, internal femoral rotation, and a pronated subtalar joint.
Breaststroker's knee

- Forceful whipping together of the lower leg produces propulsive thrust
- Excessive lateral Tibial torsion of the knee resulting in Irritation of the MCL and medial border of the patella result in onset of knee pain
- Hip abduction less than 37 or greater than 42 degree == increased onset of knee pain
Patellofemoral pain syndrome

- Painful Patellofemoral joint motion involving anterior knee pain after activities of repeated flexion at the knee
- Anatomical malalignments OR Patellar maltracking OR Large Q angle responsible
- **Weak Vastus Medialis Oblique and Vastus Lateralis strong.**

Lax medial capsular retinaculum or weak VMO muscle as a result from disuse or inhibited due to joint swelling or pain, leading to poor medial stability.

Poor timing of its contraction, which alters the ratio of firing between the VMO and vastus lateralis (VL) muscle, may lead to an imbalance of forces.

Weakness or poor timing of VMO contractions increase the lateral drifting of the patella.
Figure 2a and 2b. Diagram showing distribution of compressive forces on back of kneecap with normal patellar tracking (2a) and abnormal patellar tracking (2b).
Chondromalacia Patellae

- Overuse syndrome of patellar cartilage characterized by softening & fissuring of the articular cartilage of the patella.
- Caused by aging & mechanical defects that include:
  - Patello-femoral malalignments which lead to tracking abnormality of patella putting excessive lateral pressure on articular cartilage.
- Seen in young active women, pain worse w/stair climbing and rising from a chair.

Figure 3. Chronic anterior knee pain in adolescents may be a result of CSD or other conditions. CSD is a disturbance at the junction of the patellar tendon and the tibial tubercle apophysis (a, arrow). Sinding-Larsen-Johansson disease involves pain, swelling, and tenderness of the inferior patellar pole at the origin of the patellar tendon (b, arrow). Patients who have patellofemoral syndrome (c, shaded areas) have poorly localized peripatellar pain.
Risk Factors: Subluxation and Chondromalacia

1. Training errors
   - Increasing EXERCISE intensity too soon
2. Weak vastus medialis muscle
3. Large Q angle
4. Gender - more common in women
5. Poor footwear and/or surface
4. Osgood-Schlatter Disease

- Overuse syndrome, not a disease.
- Osgood–Schlatter disease (OSD), also known as apophysitis of the tibial tubercle, is inflammation of the patellar ligament at the tibial tuberosity.

- It is characterized by a painful bump just below the knee that is worse with activity and better with rest.
- Episodes of pain typically last a few months.
- Risk factors include overuse, especially sports which involve frequent running or jumping.
- The underlying mechanism is repeated tension on the growth plate of the upper tibia.
- Common in adolescents (8-13 year old girls and 10-15 year old boys); age of rapid bone growth
Shin Splints

- Generalized pain along the anterolateral or posteromedial aspect of the lower leg is commonly known as shin splints.
- Overuse injury often associated with running, dancing on the hard surface and running uphill.
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حس نے رب کو لیے مهکنها کی لیا وہ علم والا بہ
کیون کے علم کی موتان خاکی سے اور جائنگ کی موتان کھالی

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Feel the Magic of Good Taste
Structure of the Ankle

Tibiotalar joint

- Hinge joint where the convex surface of the superior talus articulates with the concave surface of the distal tibia
- considered to be the ankle joint
Movements at the Ankle

Dorsiflexion at the ankle

• Tibialis anterior
• extensor digitorum longus
• peroneus tertius
• assisted by:
  • extensor hallucis longus
Movements at the Ankle

plantar flexion at the ankle

• Gastrocnemius
• soleus
• assisted by:
  • Tibialis posterior, Plantaris, peroneus longus, peroneus brevis, flexor hallucis longus, flexor digitorum longus
Structure of the Foot

**Subtalar joint**

- Anterior and posterior facets of the talus articulate with superior calcaneus.
- At the anterior talocalcaneal articulation, a convex area of the talus fits on a concave surface of the calcaneus.
- The posterior talocalcaneal articulation is formed by a concave surface of the talus and a convex surface of the calcaneus.
Structure of the Foot

tarsometatarsal and intermetatarsal joints

• Nonaxial joints that permit only gliding movements
• Enable the foot to function as a semirigid unit and to adapt flexibly to uneven surfaces during weight bearing
Structure of the Foot

metatarsophalangeal and interphalangeal joints

• Condyloid and hinge joints, respectively
• Toes function to smooth weight shift to the opposite foot during walking and help maintain stability during weight bearing by pressing against the ground when necessary
Structure of the Foot

plantar arches

• The medial and lateral longitudinal arches stretch form the calcaneum to the tarsals & metatarsals

• The transverse arch is formed by the base of the metatarsal bones
Plantar Fascia

- Thick bands of fascia that cover the plantar aspects of the foot.
- **During weight bearing**—mechanical energy is stored in the stretched ligaments, tendons, and plantar fascia of the foot.
- This energy is released to assist with push-off of the foot from the surface.
Movements of the Foot

Toe flexion and extension

• **Flexion** - flexor digitorum longus, flexor digitorum brevis, lumbricals, Interossei

• **Extension** - extensor hallucis longus, extensor digitorum longus, extensor digitorum brevis
Movements of the Foot

Inversion and eversion

• **Inversion** - Tibialis posterior, Tibialis anterior
• **Eversion** - peroneus longus, peroneus brevis, assisted by peroneus tertius
Common injuries of the ankle and foot

• Ankle injuries

• Inversion sprains = stretching or rupture of lateral ligaments (ATFL, PTFL, CFL)

• Medial = deltoid ligament very strong (ATTL, PTTL, TCL, TNL)

• Ankle bracing or taping (Mild injury treatment)
Ankle sprain

- Greater inversion increases the potential for over-stretching of the lateral ligaments.
- Most sprains involve the lateral ligaments from excessive inversion.
- Of the lateral ligaments, the ATFL is sprained the most often followed by the CFL.
- Sprains occur most often with the foot in plantar flexion and inversion.
- The medial malleolus is shorter than the lateral malleolous so there is naturally more inversion than eversion.
- Deltoid ligament is sprained less often (25% of ankle sprains).
OVERUSE INJURIES

- Achilles tendinitis
- Plantar fascitis
- Stress fractures

*Dancing en pointe = stressed fracture of second metatarsal*
The plantar fasciitis

- Plantar fasciitis is one of the most common causes of heel pain.
- It involves inflammation of a thick band of tissue that runs across the bottom of your foot and connects your heel bone to your toes (plantar fascia).
- Plantar fasciitis commonly causes stabbing pain that usually occurs with your first steps in the morning. As you get up and move more, the pain normally decreases, but it might return after long periods of standing or after rising from sitting.
- Plantar fasciitis is more common in runners.
- In addition, people who are overweight and those who wear shoes with inadequate support have an increased risk of plantar fasciitis.
Alignment anomalies of foot

• Forefoot Valgus (Tarsals & metatarsals deformity); forefoot deviate laterally
• Forefoot Varus
• Hallux Valgus (metatarso-phalegeal deformity; 1st phalanx deviate laterally with respect to metatarsal)
• Hallux Varus
Injuries related to high and low arch structures

High arches (pes cavus foot) = increased incidence of ankle sprains, plantar fascitis, ITB friction syndrome, 5th metatarsal fracture

Low arches (pes planus foot) or flat feet = arches are collapsed resulting in knee pain, patellar tendinitis, plantar fascitis,
END OF LECTURE