Pes Planus

Dr. Manju Setia RMT BAMS

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- Pes planus is a decreased medial longitudinal arch and a pronated hindfoot.
- The terms **pes planus, pronated foot** and **flat foot** are often used interchangeably

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Different Regions of the Foot

- The Foot is Divided into Three Parts

1. Forefoot

The **forefoot** is the **front portion of the foot.**

Bones of the Forefoot

It consists of:

- **5 Metatarsals**
- **14 Phalanges (toe bones)**

Total = **19 bones**

Location

Starts at the **heads of the metatarsals** and extends to the tips of the toes.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Functions

- Pushes the body forward during walking.
- Helps maintain balance.
- Bears body weight during toe-off.
- Assists in propulsion during running and jumping.

Clinical Importance

- Pain in the forefoot may be caused by:
- Metatarsalgia
- Stress fractures
- Morton's neuroma
- Bunions (Hallux valgus)

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Midfoot

2. The **midfoot** is the **middle part of the foot**.

Bones of the Midfoot : There are **5 bones**:

- Navicular
- Cuboid
- Medial cuneiform
- Intermediate cuneiform
- Lateral cuneiform

Functions : The midfoot:

- Forms the arches of the foot.
- Acts as a shock absorber.
- Transfers forces from the heel to the forefoot.

Clinical Importance : Conditions include:

- Pes planus
- Midfoot sprain
- Arthritis

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

3. Hindfoot

The **hindfoot** is the **back portion of the foot**.

- **Bones of the Hindfoot**
- Only **2 bones**:
- Calcaneus (heel bone)
- Talus

Functions

- Supports body weight.
- Transfers force from the leg to the foot.
- Forms the ankle and subtalar joints.

Clinical Importance : Common problems:

- Heel pain
- Achilles tendinitis
- Calcaneal fracture
- Subtalar arthritis

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

How Pronation Affects These Regions

During **pronation**:

- **Hindfoot:** Calcaneus everts (heel tilts outward).
- **Midfoot:** Arch flattens as the midfoot becomes more flexible.
- **Forefoot:** Abducts (moves outward away from the body's midline).

During Supination

The opposite happens:

- **Hindfoot:** Inverts (heel tilts inward).
- **Midfoot:** Arch rises and becomes rigid.
- **Forefoot:** Adducts (moves toward the body's midline).

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Two Types of Pes Planus

1. Functional (Flexible) Pes Planus

Cause:

- Weak muscles
- Loose ligaments
- Poor muscle control

Characteristics:

- Arch appears when sitting.
- Arch disappears while standing.
- Correctable.

Clinical Example

- A patient stands and the arch flattens. When sitting, the arch returns.
- → Functional Flat Foot.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

2. Structural (Rigid) Pes Planus

Cause:

- Bone deformity
- Congenital abnormality
- Arthritis
- Joint fusion

Characteristics:

- Arch remains flat all the time.
- Present in sitting and standing.
- Cannot be corrected manually.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Three Foot Arches

1. Medial Longitudinal Arch (Most Important)

- Highest and most flexible arch.
- **Bones forming the arch**
- Calcaneus
- Talus
- Navicular
- Three Cuneiforms
- First three Metatarsals
- **Ligaments supporting it**
- Long Plantar Ligament
- Short Plantar Ligament
- Plantar Calcaneonavicular (Spring) Ligament
- Plantar Aponeurosis (Plantar Fascia)

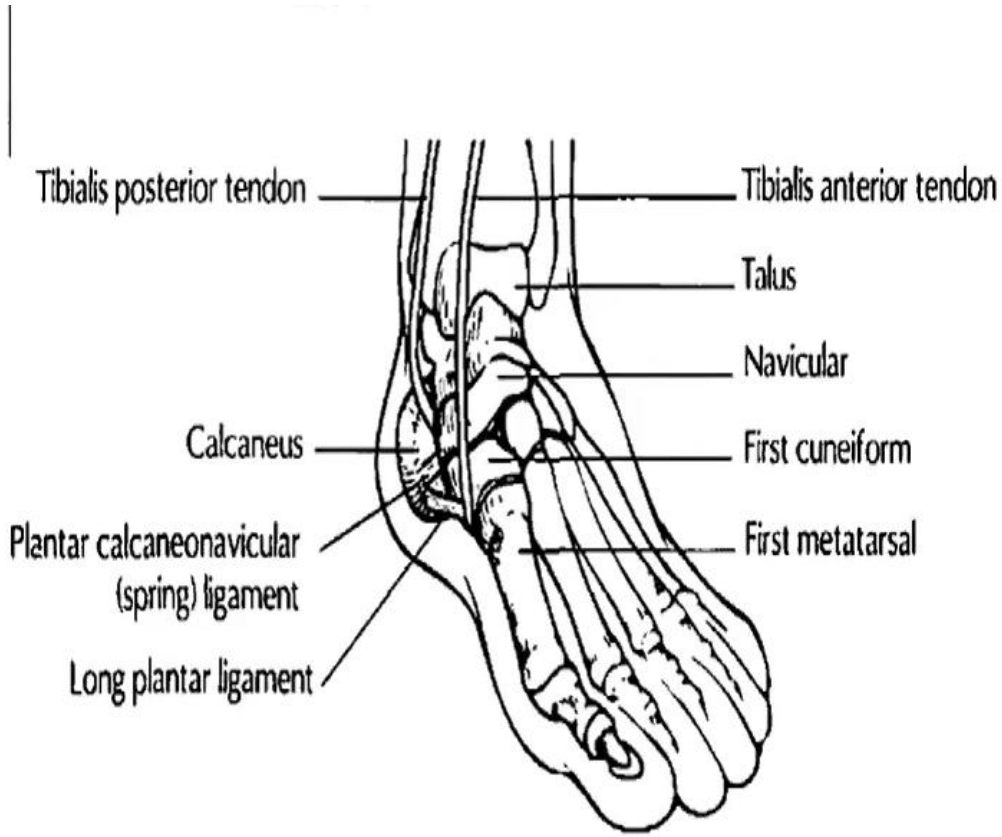


Figure 39.1
The medial longitudinal arch.

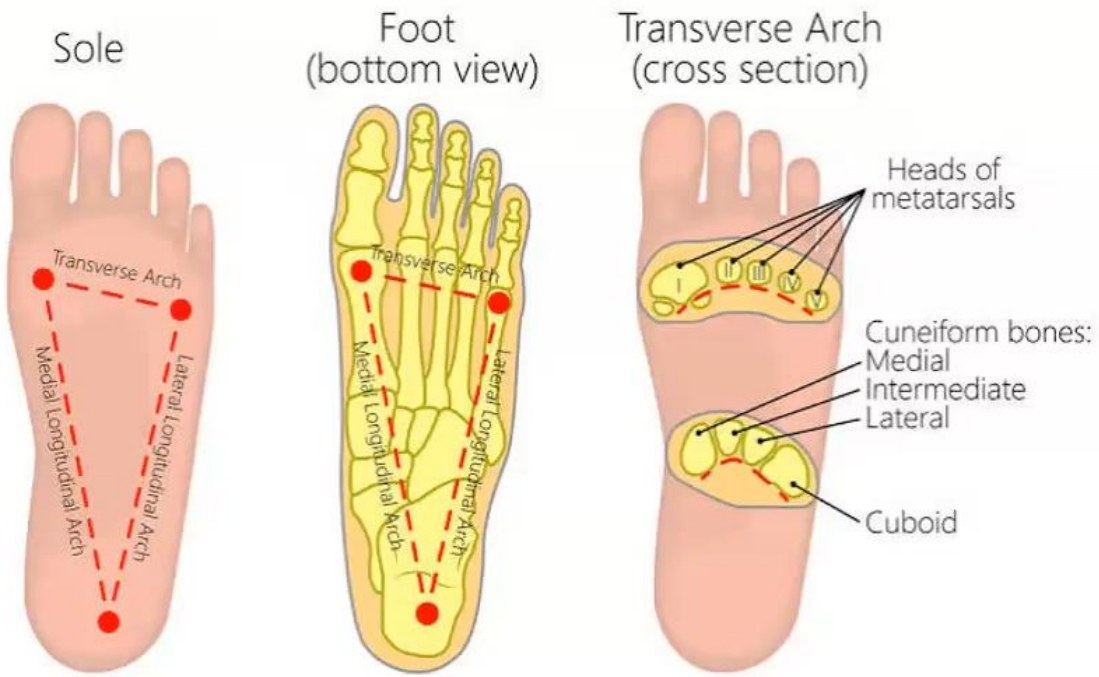
RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Muscles supporting it dynamically

- Primary muscles:
- Tibialis Posterior
- Tibialis Anterior
- Peroneus Longus
- Additional support:
- Flexor Hallucis Longus
- Flexor Digitorum Longus
- Intrinsic Foot Muscles

3. Anterior Transverse Arch

- Located across the metatarsal heads.
- Supported mainly by:
- Lumbricals
- Interossei
- These muscles keep the metatarsal heads properly aligned.



RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Development of Foot Arches

Newborn babies have:

- No arches
- This is completely normal.
- The medial longitudinal arch begins developing around:
- **2 years of age**
- There fore: Flat feet in infants are normal.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Twisted Plate Theory

- Imagine the foot as a **twisted plate**.
- When the foot is:

Supinated

- Twist increases
- Arch becomes higher
- Foot becomes rigid

Pronated

- Twist decreases
- Arch flattens
- Foot becomes flexible
- This explains why pronation lowers the arch.

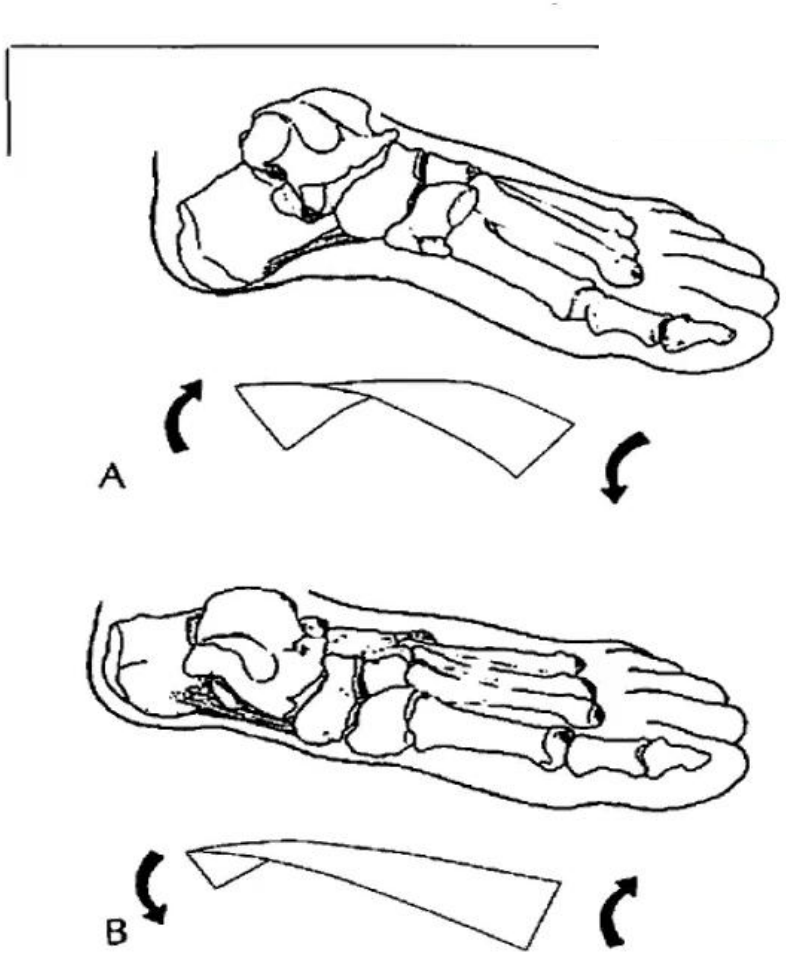


Figure 39.2
The medial longitudinal arch: A) twisting into supination; B) untwisting into pronation.

Pronation During Walking

- Normal gait requires **a small amount of pronation** after heel strike.
- Benefits:
- Shock absorption
- Adapts to uneven surfaces
- Allows tibial internal rotation
- This is **normal pronation**.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Supination During Toe-Off

- During push-off:
- The **plantar aponeurosis tightens**.
- This is called the **Windlass Mechanism**.
- Result:
- Medial arch rises.
- Foot becomes rigid.
- Better propulsion.

What Happens in Pes Planus?

Normal Alignment:

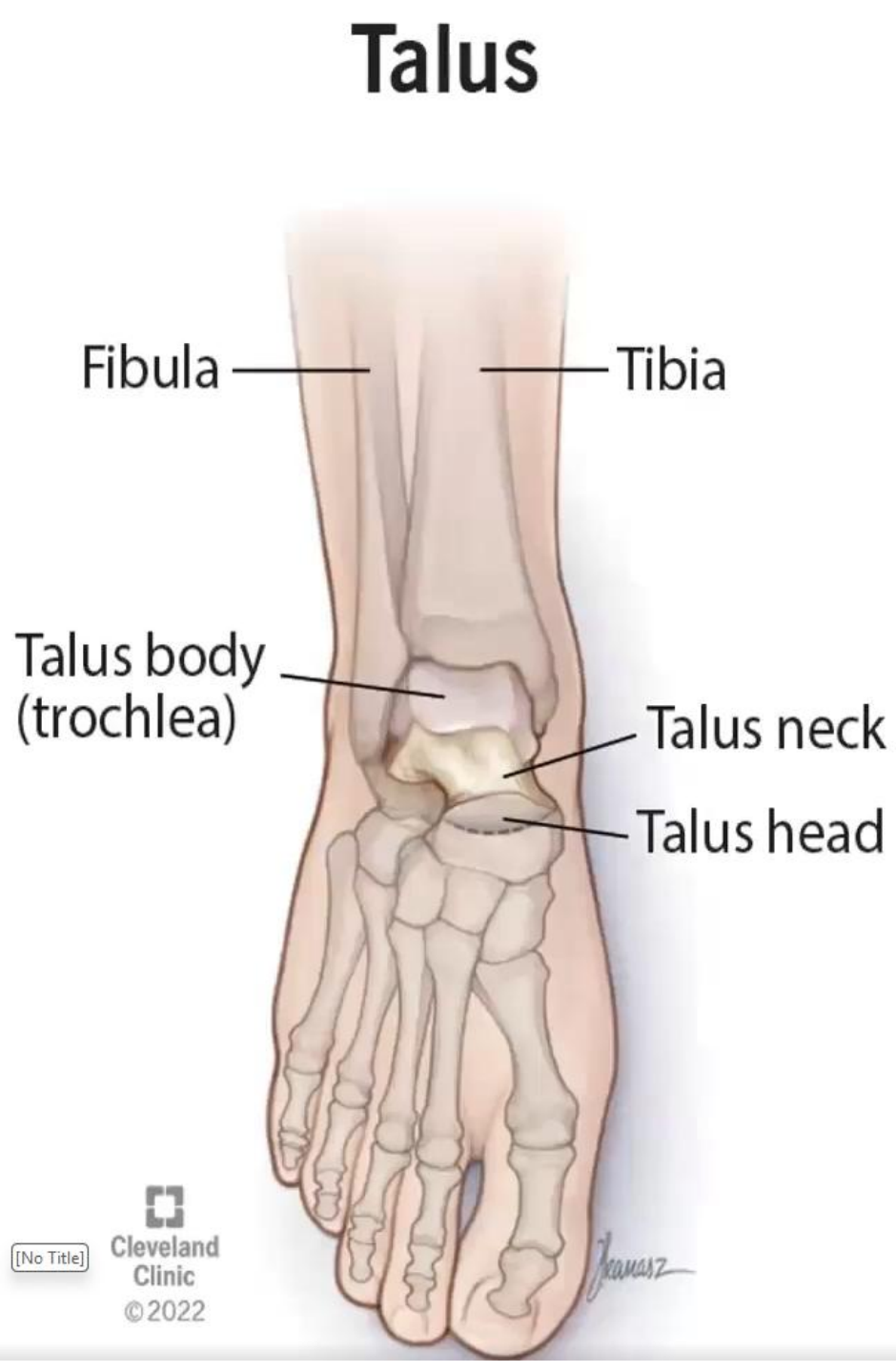
- Talus sits properly on the Navicular.

In Flat Foot:

- The **head of the talus** moves:
- Medially
- Inferiorly

As a result:

- Arch collapses.
- Ligaments overstretch.
- Plantar fascia stretches.
- Joint capsules become loose.



Effect on Ligaments

- The following structures become overstretched:
- Spring ligament : also called the **plantar calcaneonavicular ligament**) is a strong ligament located on the **medial (inner) side of the foot**.
- **Attachments**
  - **Proximal attachment:** sustentaculum tali of the calcaneus
  - **Distal attachment:** Plantar surface of the head of the talus and the navicular
- Long plantar ligament
- Short plantar ligament
- Plantar fascia
- Joint capsules
- Eventually these tissues lose their ability to support the arch.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Muscle Compensation

- Since ligaments become weak, muscles must work continuously.
- Normally these muscles are quiet during standing.
- In Pes Planus they become overactive:
- Tibialis Posterior
- Tibialis Anterior
- Peroneus Longus
- Long Toe Flexors
- Intrinsic Foot Muscles

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Result:

- Muscle fatigue

↓

- Pain

↓

- Trigger points

↓

- Further arch collapse

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Muscle Types

- **Phasic Muscles**
- Characteristics:
- Designed for movement
- Fatigue easily
- Become weak
- Examples:
- Tibialis Anterior
- Peroneal Muscles

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Postural Muscles

- Characteristics:
- Designed for endurance
- Become tight instead of weak
- Examples:
- Gastrocnemius
- Soleus
- These muscles commonly shorten in flat-foot patients.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Peroneal Muscles

- **Peroneus Longus**
- Insertion:
- Base of First Metatarsal
- Medial Cuneiform
- Function:
- Everts foot indirectly
- Supports medial arch
- Pushes first metatarsal into the ground
- **Peroneus Brevis**
- Insertion:
- Base of Fifth Metatarsal
- Function:
- Directly everts foot

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **Peroneus Tertius**
- Insertion:
- Fifth Metatarsal

Function:

- Dorsiflexion
- Eversion

Why Peroneals Become Tight

- Because the foot remains pronated:
- Peroneals stay shortened.
- Trigger points develop.
- They keep pulling the foot outward.
- Flat foot worsens.
- This creates a vicious cycle.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Gastrocnemius & Soleus

- These postural muscles often become adaptively shortened.
- Tight calves:
- Limit ankle dorsiflexion.
- Increase pronation during walking.
- Place more stress on the medial arch.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **What Happens if Functional Pes Planus Is Not Treated?**
- Without proper arch support:
- Ligaments continue stretching.
- Muscles fatigue more quickly.
- The arch progressively collapses.
- Pain and biomechanical problems increase.

A study of people completing a **100 km hike** found that those with existing pes planus experienced a further drop in their arches after the walk, while participants with normal arches showed no significant change. This demonstrates how prolonged loading can worsen an unsupported functional flat foot.

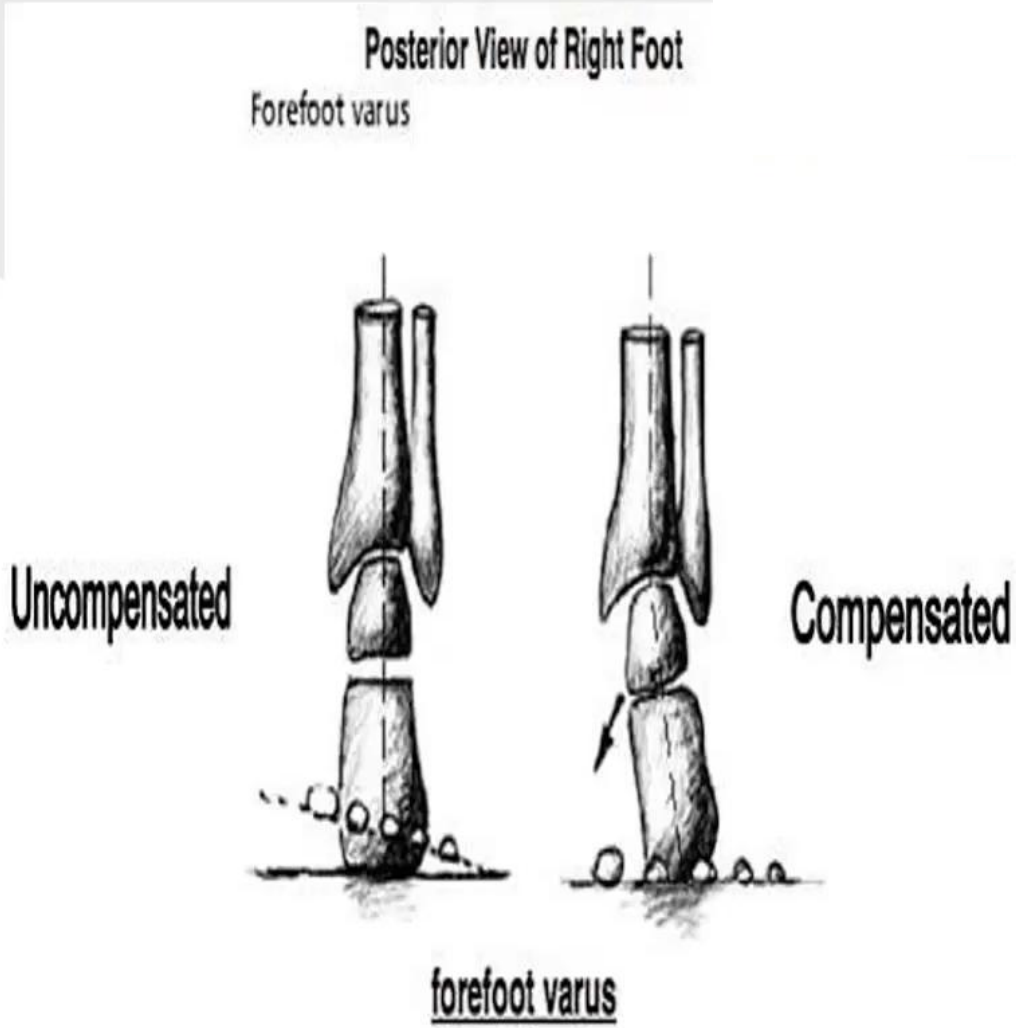
RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Other foot problems the therapist may see:

1. Forefoot Varus

Definition:

- **Forefoot varus** is a structural deformity where the **forefoot is inverted (turned inward) compared with the hindfoot** at the **midtarsal joint**.
- **Simple explanation:**
- The **back of the foot (hindfoot)** is relatively normal.
- The **front of the foot (forefoot)** is tilted inward.
- When the person stands, the body tries to compensate by **rolling the foot inward (pronation)** to bring the forefoot flat to the ground.



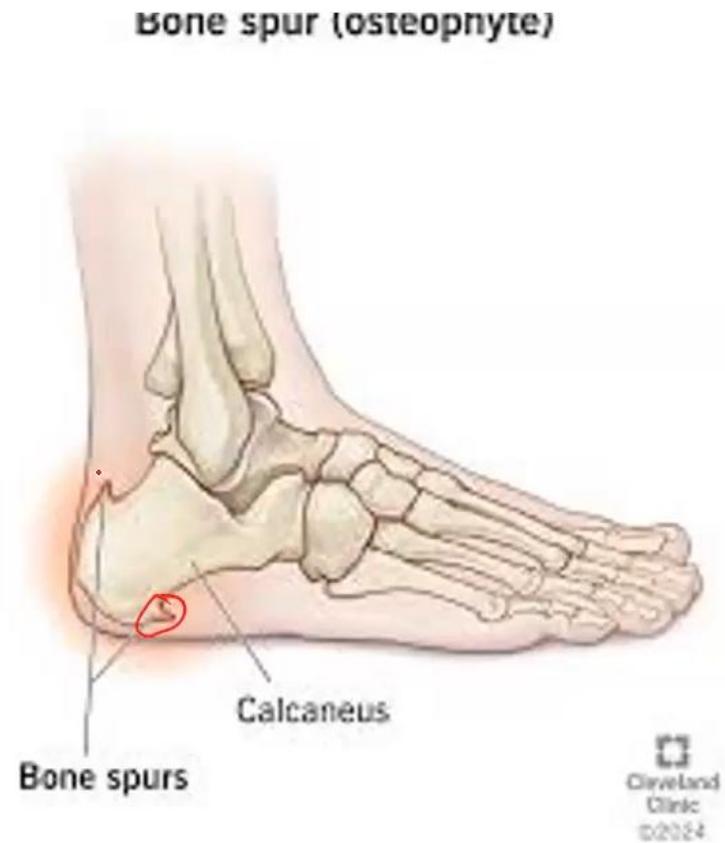
RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Appearance:

- Although the problem is an inward tilt of the forefoot, clinically it may **like pes planus (flat foot)** because the foot collapses into pronation during weight bearing.
- **Problems associated:**
- **1. Tibialis Posterior Tendinitis**
- Excessive pronation places extra stress on the **tibialis posterior tendon**.
- Over time, the tendon becomes irritated and painful.
- Tibialis posterior normally supports the medial arch.
- **2. Morton's Neuroma**
- Excessive pressure between metatarsal heads can irritate the digital nerve.
- Usually occurs between the **3rd and 4th metatarsals**.
- Symptoms:
  - Burning pain
  - Tingling
  - Feeling of a pebble under the foot

2. Heel Spurs

- **Definition:**
- A **heel spur** is a bony growth that develops due to **chronic pulling stress on the attachment of the plantar aponeurosis (plantar fascia)**.
- **Mechanism:**
- The medial longitudinal arch begins to flatten.
- The plantar fascia becomes overstretched.
- Continuous pulling occurs at its attachment on the calcaneus.
- The body responds by forming extra bone → **heel spur**.



RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

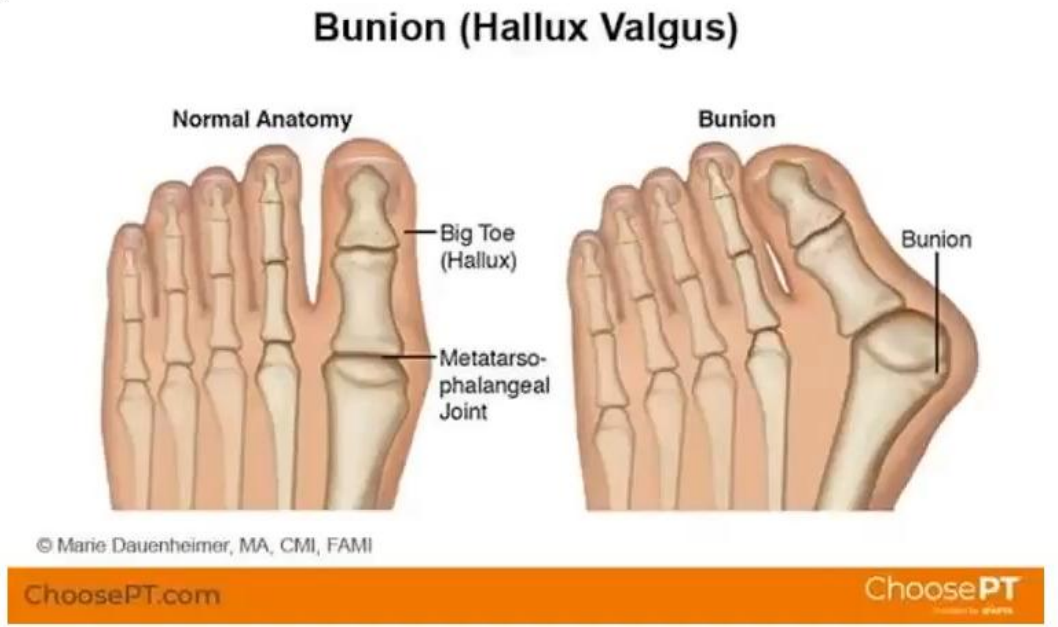
Common location:

- Bottom of the heel
- Attachment of plantar fascia to the calcaneus
- **Symptoms:**
- Sharp heel pain
- Worse with first steps in the morning
- Pain after prolonged standing
- **RMT Considerations:**
- Treat contributing factors:
- Tight gastrocnemius
- Tight soleus
- Plantar fascia tension
- Poor foot mechanics

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

3. Hallux Valgus (Bunion)

- **Definition:**
- **Hallux valgus** is a deformity where:
- The **big toe (hallux) moves laterally toward the other toes** (valgus).
- The **first metatarsal bone moves medially** (toward the inside of the foot).
- **Simple explanation:**
- The big toe drifts outward, while the first metatarsal pushes inward, creating a bump.



ROHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Causes:

- Footwear with a narrow toe box
- High heels
- Genetic factors
- Pes planus (flat feet)
- **Relationship with Pes Planus:**
- Flat feet increase stress on the first metatarsophalangeal joint and may contribute to hallux valgus.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Changes that occur:

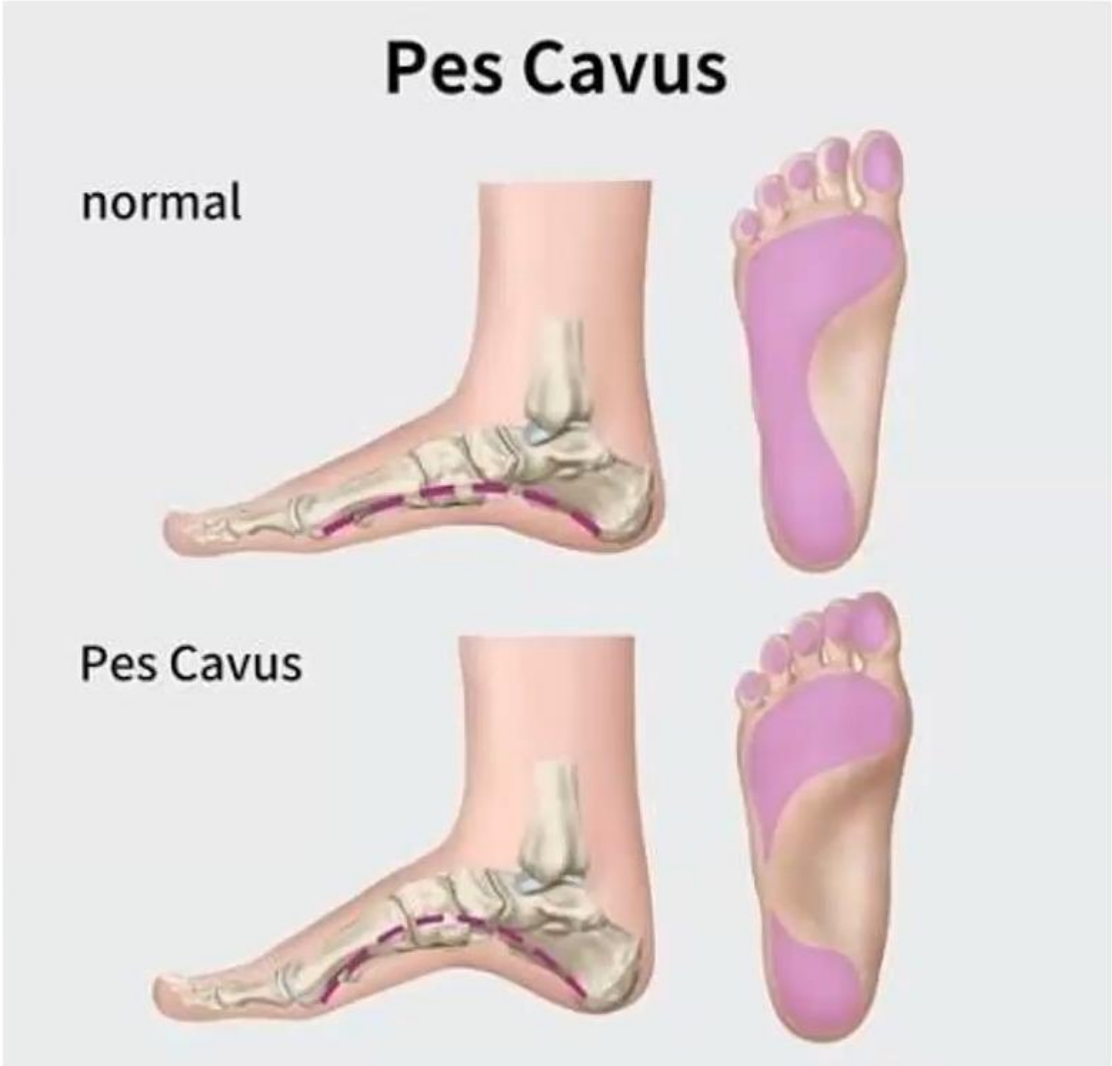
- **1. Joint Capsule Changes**
- The first MTP joint capsule becomes **loose and unstable (hypermobile)**.
- **2. Bunion Formation:**
- A bunion develops due to:
- Thickened joint capsule
- Inflamed bursa
- Callus formation
- **Symptoms:**
- Pain around big toe joint
- Swelling
- Difficulty wearing shoes

Clinical Considerations:

- Avoid aggressive pressure directly over:
- Bunion
- Inflamed bursa
- Focus on:
- Foot muscles
- Calf muscles
- Plantar fascia

4. Pes Cavus (High Arch Foot)

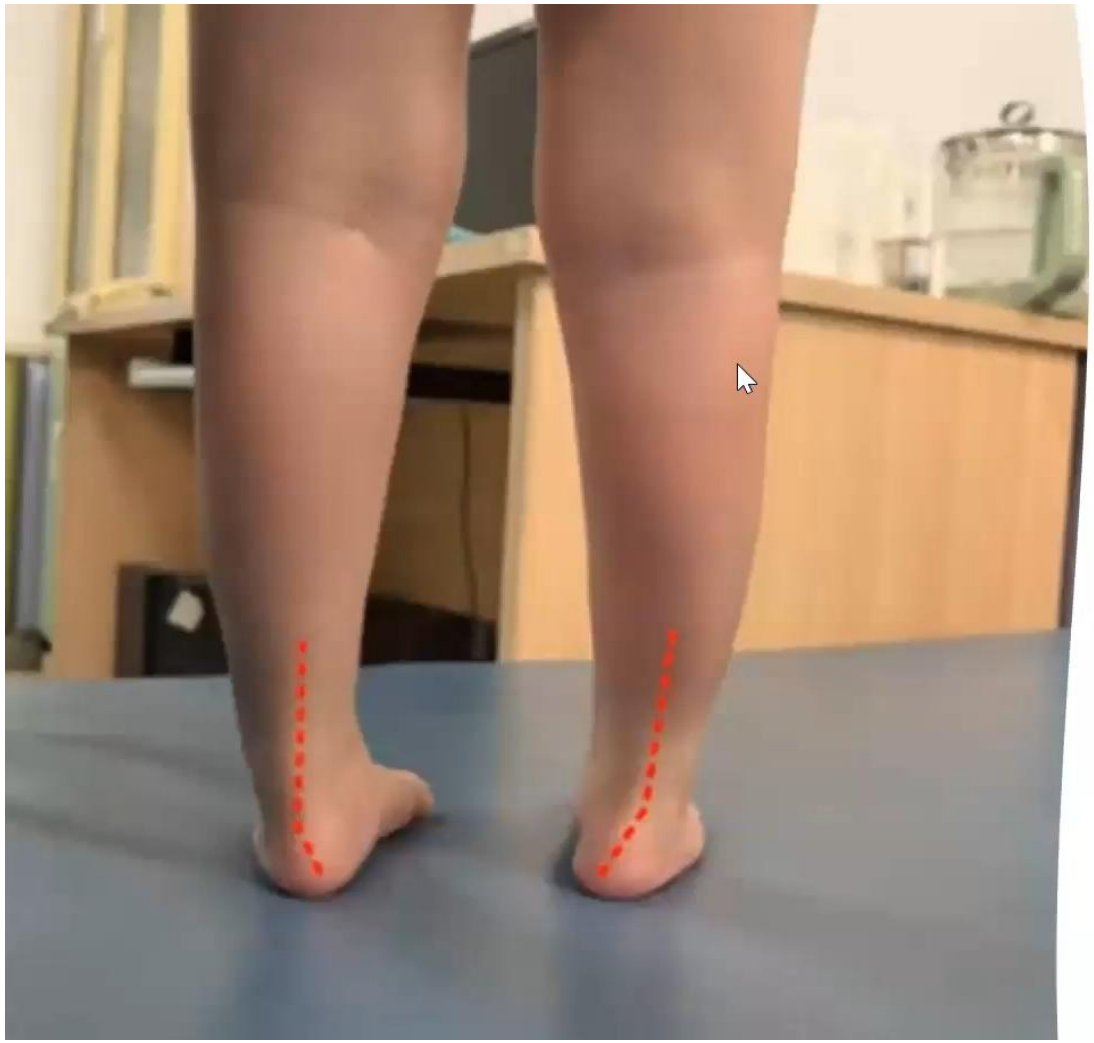
- **Definition:**
- **Pes cavus** is the opposite of pes planus.
- Pes planus = flat arch
- Pes cavus = excessively high arch
- **Cause:**
- Occurs due to excessive **supination** of the foot.
- **Foot position:**
- Increased inversion of calcaneus
- High medial longitudinal arch
- Less shock absorption



Muscle Changes in Pes Cavus

Shortened muscles:

- **1. Tibialis Anterior**
- Function:
- Dorsiflexion
- Inversion
- **2. Tibialis Posterior**
- Function:
- Plantarflexion
- Inversion
- Supports medial arch
- **3. Toe Flexors**
- Function:
- Curl toes
- Help maintain arch
- Because these muscles are shortened, the foot becomes rigid and supinated.



5. **Hind foot Varus**

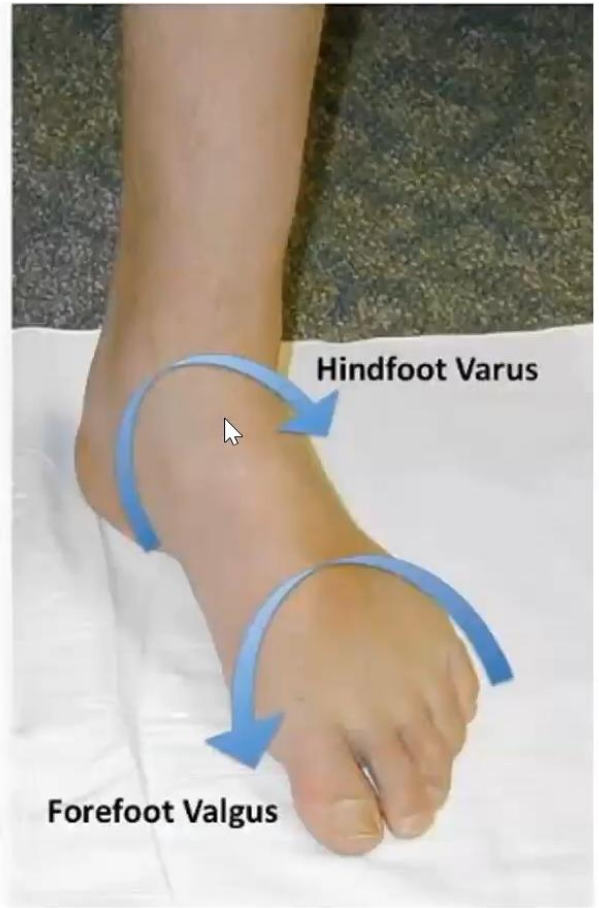
Definition:

- **Hindfoot varus** is inversion of the calcaneus.
- **Simple explanation:**
- The heel tilts inward.
- **Associated with:**
- Supination
- Pes cavus
- **Opposite:**
- Hindfoot valgus = heel tilts outward (seen in pronation/pes planus)

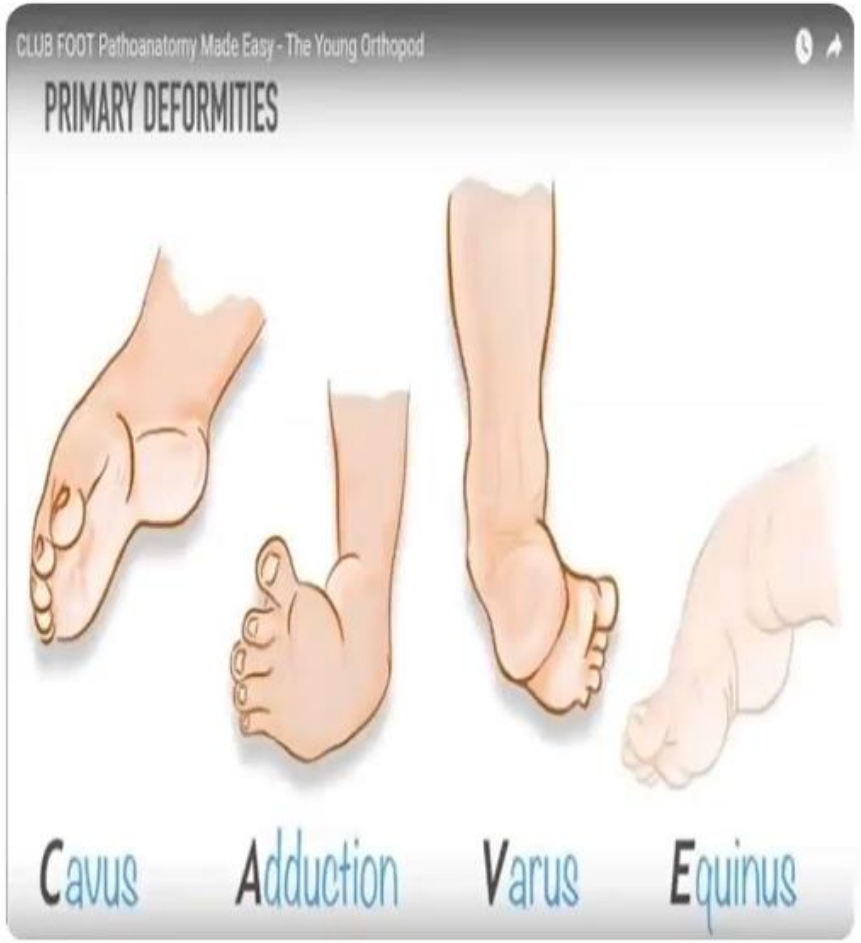
- **6. Forefoot Valgus**
- **Definition:**
  - Forefoot valgus occurs when the **forefoot everts (turns outward) compared with the hindfoot** at the midtarsal joint.
- **Appearance:**
  - It may clinically resemble **pes cavus** because the person compensates with supination.
- **Simple analogy:**
  - Think of the foot like a book:
    - Forefoot varus →front of book tilts inward
    - Forefoot valgus →front of book tilts outward

A FOREFOOT VALGUS DEFORMITY

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY



RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY



- **Metatarsalgia** is a general term for foot pain experienced under the metatarsal heads. It may occur with either pes planus or pes cavus.
- **Congenital talipes equinovarus (CTEV)**, also called **clubfoot**, is a congenital deformity in which one or both feet are abnormally positioned at birth due to abnormal development of bones, muscles, tendons, and ligaments.
- **The four components of clubfoot (CAVE mnemonic)**
- **C – Cavus:** High medial arch due to plantar flexion of the first metatarsal.
- **A – Adductus:** Forefoot is deviated medially.
- **V – Varus:** Heel (hindfoot) is inverted.
- **E – Equinus:** Ankle is plantar-flexed, with the heel pointing downward.

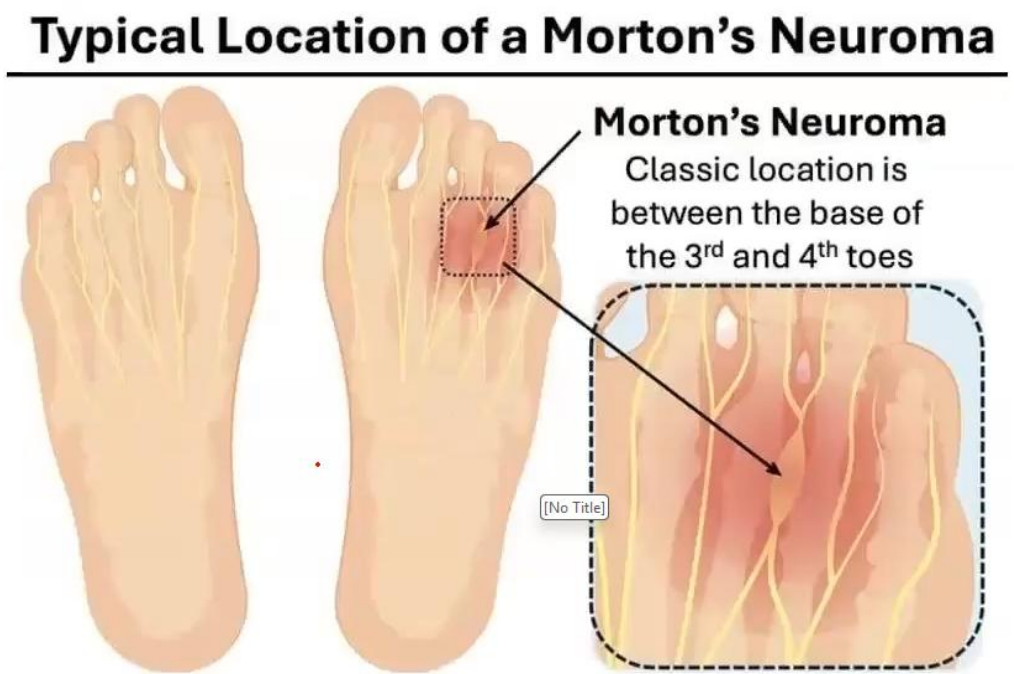
RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **Morton’s Foot Structure**
- **Second metatarsal is longer than the first metatarsal.**
- First metatarsal becomes **too mobile (hypermobile)**.
- During **toe-off phase of gait**, more body weight goes through the **2nd metatarsal head**.
- Causes:
  - Pain and tenderness under the 2nd metatarsal head.
  - **Callus formation** due to increased pressure.
- Can increase stress on **tibialis posterior muscle**.
- Often associated with **pes planus (flat foot)**.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Morton's Neuroma

- A **thickening/swelling of the interdigital nerve** in the foot.
- Usually occurs between the **3rd and 4th metatarsals**.
- Caused by:
  - Compression of the nerve between metatarsal bones.
  - Excessive movement (hypermobility) of metatarsals.
- Symptoms:
  - Burning pain, tingling, or numbness in the toes.
  - Pain increases with **walking or weight bearing**.
  - Tight shoes can make symptoms worse.



RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Causes of Pes Planus

- **1. Joint & Ligament Laxity**
  - Loose joint capsules and ligaments allow excessive foot movement.
  - Can be inherited or caused by conditions like rheumatoid arthritis.
- **2. Poor Foot Biomechanics**
  - Abnormal movement of the **subtalar** and **midtarsal joints** can collapse the arch.
- **3. Tight Muscles & Tendons**
  - Tight **gastrocnemius, soleus, and Achilles tendon** limit ankle dorsiflexion.
  - Foot compensates by pronating, causing arch flattening.
- **4. Muscle Weakness**
  - Weak **tibialis posterior** (main arch-supporting muscle) reduces dynamic arch support.
- **5. Bone Abnormalities**
  - Abnormal foot bones or joint fusion can affect arch formation.
  - Long second metatarsal and hallux valgus may contribute.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Causes of Pes Planus (Flat Foot)

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Self-Care Plan

- **1. Reduce Stress on the Medial Longitudinal Arch**
- Avoid high-stress activities without arch support.
- Wear **supportive sandals/shoes** instead of walking barefoot.
- Use **contrast foot baths** after prolonged standing or stressful activities.
- Apply **ice** if inflammation occurs (e.g., plantar fasciitis).
- Perform self-massage:
  - Lengthening techniques → shortened muscles.
  - Stimulating techniques → fatigued muscles.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **2. Stretch Tight Muscles**
- Stretch muscles that contribute to abnormal foot mechanics:
- **Gastrocnemius**
- **Soleus**
- **Peroneus longus**
- **Peroneus brevis**
- **Peroneus tertius**

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **3. Strengthen Weak Muscles**
- **Tibialis Anterior**
- Exercises:
  - Dorsiflexion
  - Inversion
  - Adduction
- Use resistance bands/theraband.
- **Tibialis Posterior**
- Exercises:
  - Inversion
  - Plantarflexion against resistance.
- **Intrinsic Foot Muscles**
- Toe gripping exercises:
  - Pick up pencils or pebbles with toes.
  - Towel scrunching exercises.

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

- **4. Referral for Supportive Devices**
- Clients with postural/functional pes planus may benefit from:
- Partial shoe inserts
- Supportive footwear
- Orthotics
- **Benefits:**
- Support the medial arch.
- Control excessive calcaneal movement.
- Reduce fatigue and pain.
- **Orthotic Adaptation:**
- Start gradually:
  - Wear 1–2 hours initially.
  - Increase wearing time slowly.

[No Title]

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY

Treatment Frequency & Expected Outcome

- **Frequency**
- Treatment: **1 session/week for 6 weeks**
- Reassessment after 6 weeks.
- Review exercise and self-care program.
- **Expected Outcome**
- Functional pes planus has a **good prognosis** if the client follows the program.
- Ligaments that have stretched cannot return completely to original length.
- Strengthening muscles and using arch supports can:
  - Improve foot stability.
  - Reduce fatigue and pain.
  - Prevent further arch collapse.
  - Reduce risk of injuries such as tendinitis.
- **High-activity clients (runners/hikers) especially benefit from strengthening and arch support to prevent progression.**

RUHANI COLLEGE
OF HEALTH BUSINESS AND TECHNOLOGY