METATARSOPHALANGEAL (MTP) JOINT AND INTERPHALANGEAL(IP) JOINT OF THE FOOT

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METATARSOPHALANGEAL(MTP) JOINT

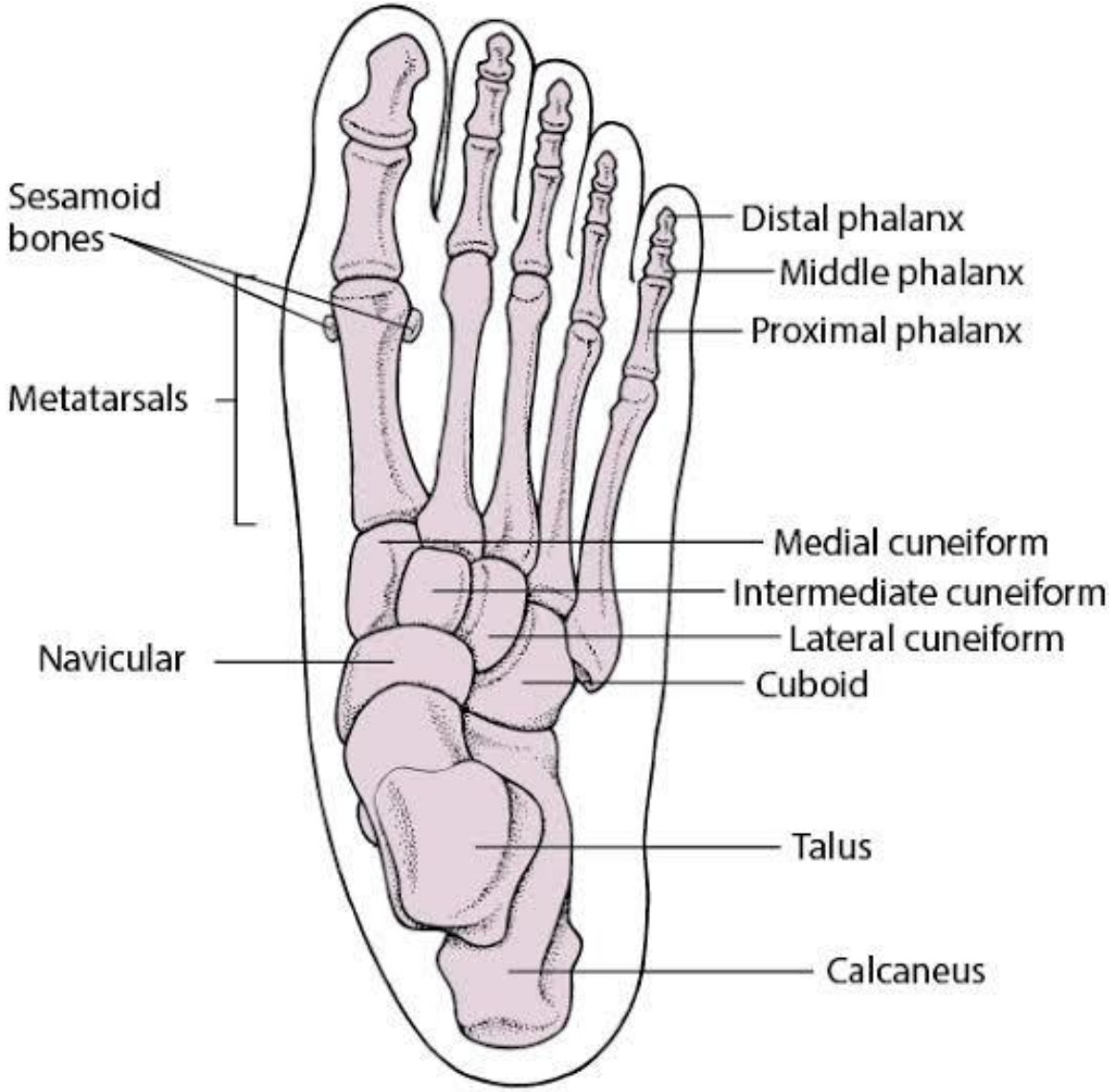
- The MTP joints are the joints between the metatarsal bones of the foot and the proximal bones(proximal phalanges).
- They are **condyloid synovial joints.**
- two degrees of freedom**.: Flexion/extension**

Abduction/ adduction.

JOINT STRUCTURE

- It is formed proximally by the **convex head of metatarsals** and distally by the **concave base of the proximal phalanges**.
- All metatarsals bear weight in stance phase of gait cycle.

- The sesamoid bones serves as anatomic pulley for the **flexor hallucis brevis** muscle and protect the tendon of **flexor hallucis longus** weight-bearing trauma.
- The sesamoid bones absorb weight-bearing stress, along with the relatively large quadrilaterally shaped first metatarsal head.
- With toe extension greater than 10◦ , the sesamoid bones no longer lie in their grooves and may become unstable.
- Chronic lateral instability of the sesamoid bone may lead to metatarsophalangeal deformity.


Sesamoid bones
Metatarsals
Navicular
Distal phalanx
Middle phalanx
Proximal phalanx
Medial cuneiform
Intermediate cuneiform
Lateral cuneiform
Cuboid
Talus
Calcaneus

Dorsal View

- Stability of MTP joints are provided by **a joint capsule, plantar plates, collateral ligaments and deep transverse metatarsal ligament.**

- The **plantar plates are fibro cartilaginous structure, connected to the base of proximal phalange** distally and blend with the joint capsule proximally.

FUNCTION

- Two degrees of freedom
- Flexion/ extension and Abduction/ adduction
- ROM:
  - **FLEXION- 17**
  - **EXTENSION-82**

- The range of extension varies with weight bearing

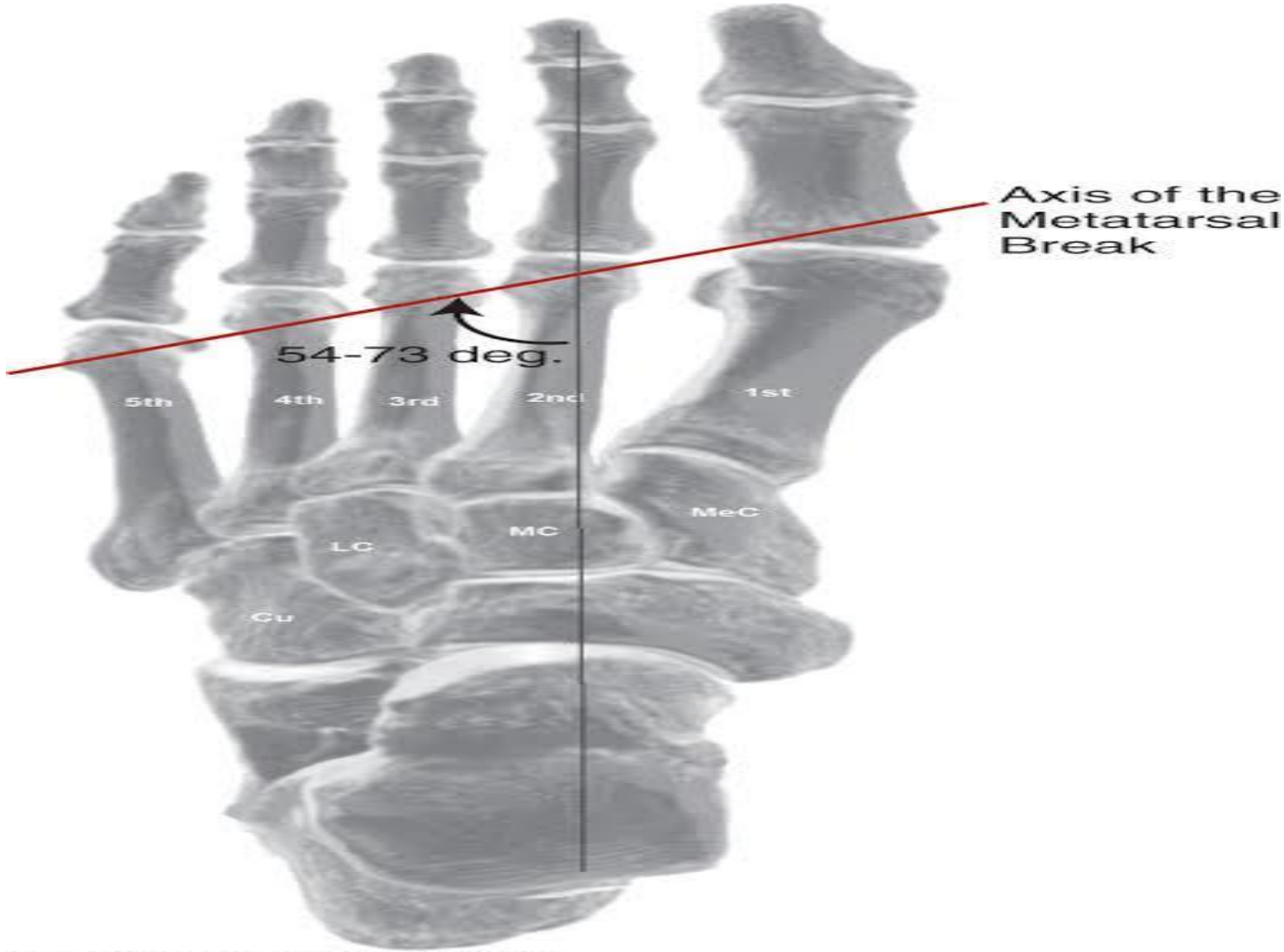
and non weight bearing.

The range of extension is **more during weightbearing.**

- The MTP joint primarily allow the weight bearing foot to rotate over the toes through **MTP extension** known as **Metatarsal break.**

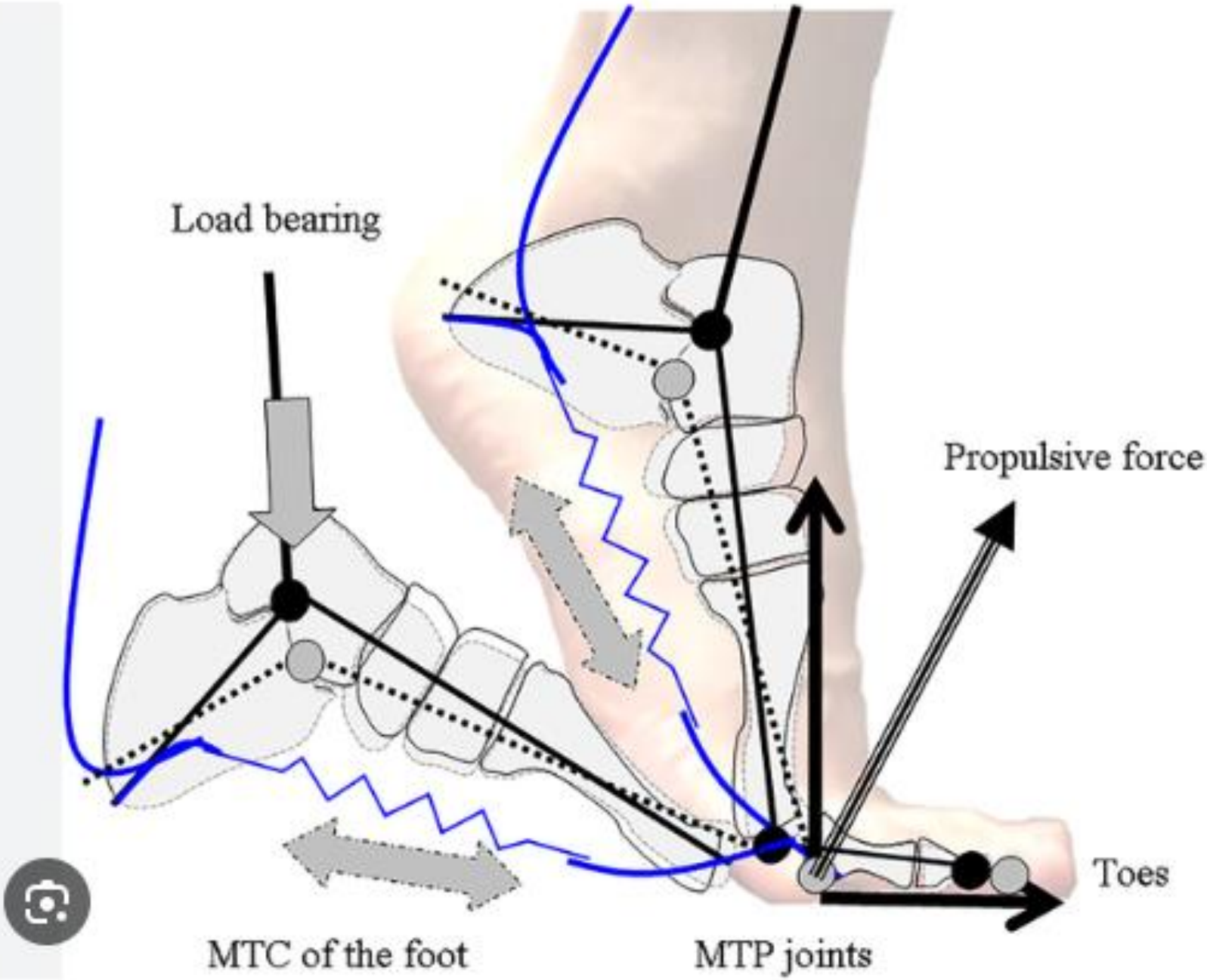
Metatarsal break

- It occurs at the MTP joint during walking, **the heel rises and the metatarsal head and toes remain weight bearing.**
- The metatarsal break occurs around a **single oblique axis** that lies through **second to fifth metatarsal head**.
- The angle of the axis around which the metatarsal break occurs may range from **54⁰ to 73⁰** with respect to the long axis of the foot.



Source: Pamela K. Levangie, Cynthia C. Norkin: Joint Structure and Function: A Comprehensive Analysis, Fifth Edition, www.FADavisPTCollection.com

- The break occurs as the hind foot leaves the ground , the weight passes anteriorly through forefoot and metatarsal head slides plantar wards on the fixed phalanges.
- Limited extension ROM at the first MTP joint will interfere with the metatarsal break and is known as **hallux rigidus.**


Load bearing
Propulsive force
Toes
MTC of the foot
MTP joints

Metatarsalgia

INTERPHALANGEAL JOINT(IP) JOINT

- **synovial hinge joints**
- Articulating surfaces : between proximal and distal phalanges
- One degree of freedom
  - Flexion / extension
- Great toe has only one IP joint connecting two phalanges whereas the four lesser toes have 2 IP joint (proximal and distal IP joints) that connect 3 phalanges.

- The flexor hallucis longus and flexor digitorum longus flex the IP joint of the big toe and lateral four toes.
- They are supported by a joint capsule, collateral ligaments, and a plantar plate.
- The plantar plate serves a purpose similar to that of the palmar plate at the metacarpophalangeal joints, protection of the underlying articular surface.

FUNCTION

- To smoothen the weight shift to opposite foot in gait.
- Helps to maintain stability by pressing against ground in standing.

PATHOMECHANICS

1.HALLUX VALGUS :

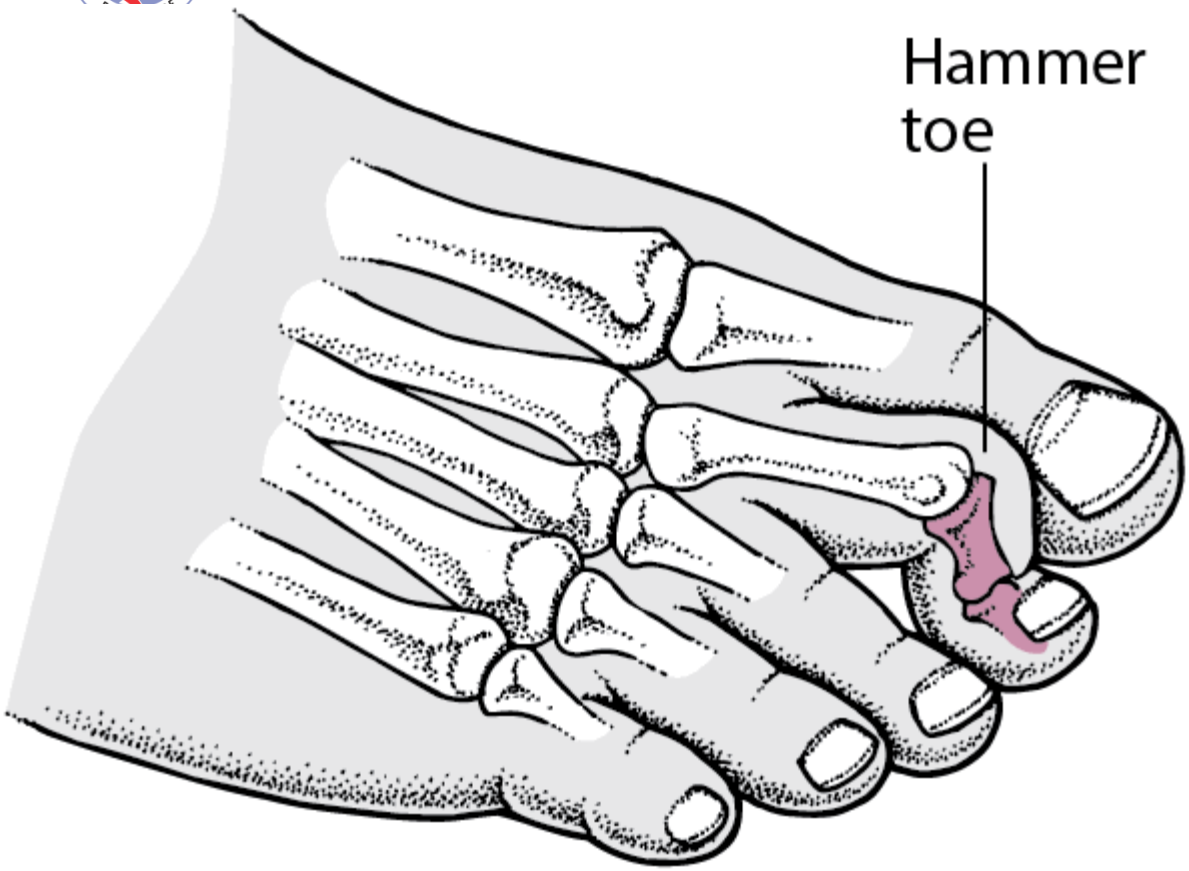
- The hallux valgus complex is characterized as a combined deformity with a **malpositioning in the first metatarsophalangeal (MTP) joint with lateral deviation of the great toe and medial deviation of the first metatarsal bone.**
- It is the most common pathology of the big toe.

- Typical complaints are pain over the medial eminence, local skin or bursa irritation, medial deviation of the first ray, lateral deviation and pronation of the great toe.

- Non-operative treatment includes footwear modification such as accommodating shoes with a wide toe-box, padding over the medial eminence, adjustments to the shoe, night splints or physical therapy and insoles.

2.HAMMER TOE DEFORMITY

- Most common deformity of the lesser toes.
- **proximal IP joint flexion deformity, compensatory hyper extension of the MTP and distal IP joint** typically occurs.
- The PIP joint prominent dorsally.


Hammer
toe

3.HALLUX RIGIDUS

- Also called **stiff big toe.**
- It is a form of degenerative arthritis that causes pain and stiffness.
- It can occur through overuse of the joint.
- The toe position is **changed from a neutral position to full extension**.
- The contact distribution shifted dorsally with increasing degrees of extension.
- The osteophyte limit first MTP joint motion and further compromise the normal mechanics of the joint.

Fig 6: Hallux rigidus

THANK YOU