GAIT

- The body has evolved to minimize joint damage from the normal forces it is subjected to
- Muscles and ligaments resist excessive damaging movement
- Muscles and ligaments cushion joints
- Muscles and ligaments place joints in the correct position when aligned properly and allow the correct forces with respect to load and direction to be applied

Dysfunction occurs when

- increase in carriage of weight
- adding momentum e.g. running
- damaged weak or fatigued muscle cannot reduce shock
- altered optimal alignment

Correct standing posture

- the correct centre of gravity is in the middle of the sacrum and b/w the SI joints
- the weight of the trunk is transmitted through the ilio lumbar ligaments to the hip joints
- half the body weight should be borne by each limb
- a vertical line drops behind the hip therefore extending it
- in front of the centre of the knee therefore extending it
- in front of the ankle therefore dorsi flexing it

The hip in standing

- it is in its close packed position i.e. full femoral extension and medial rotation
- evenly placing feet to bare weight toes pointing forward and slightly lateral, knees flexed and ankle dorsi flexed (jts are out of their close packed position)
- with one leg forward the majority of the weight is born by the posterior leg which challenges your back muscles and ligaments
- with correct hip position minimal muscle energy is required as a natural sway exists to adjust from fatiguing fibers to rested ones

<u>Stance phase</u>

Contact period - 30% of stance phase

- .15 seconds duration

- Ideally at heel strike slight rear foot inversion, 5º d.flexion and knee fully extended

- with progression in this phase of gait, the subtalar jt pronates ~8º bringing the medial forefoot to the ground, ankle plantar flexes and the knee flexes~30º
- the joints are not closed packed knee and hip flexed and ankle d flexed

Primary function of the foot is to absorb shock and make accommodations for rough terrain

Mechanisms involved in shock absorption

1. subtalar pronation (jt b/w talus and calcaneus) allows a gradual lowering of the ankle jt via tibialis ant and post more time to dampen forces (via eccentric contraction (compare bicep triceps function and catching ball and elbow flexion)
2. pronation allows better accommodation on the mid foot to uneven ground
3. gradual loading after lateral forefoot contact to 1st MT head contact sets in play a neural chain of events

forefoot contacts the ground
↓
forefoot widens via MT fanning
↓
mechanoreceptor activation in the interossei mm
MT & IP jts
↓
mechanoreceptors cause immediate reflex contraction
of extensors i.e. the quads 1ºacting to stabilize the lower limb
(the positive support reaction)
↓
contact period ends with subtalar pronation
slight plantar flexion in ankle jt
knee flexed to ~30º

there is conflict in research with the significance of muscles in limiting subtalar pronation (tibialis anterior & posterior)

Midstance period

- occurs between full forefoot load and heel lift
- foot held in mild pronation
- storage of energy from the contact period in the ligaments and muscles in preparation for propulsion 1º plantar fascia, short and long plantar ligaments,
- the plantar fascia has an enormous role in maintaining integrity of the medial arch. Severing to reduce pain in plantar fascitis cases leads to collapsing of the arch
- at the end of stance the limb is extended partly passively via forward momentum and partly actively
- this limb lengthening is used to provide forward propulsion to the trunk
- the knee remains flexed and is required to have good muscle control as it is in its loose packed position . if this is not present then the end result is injury to passive structures

propulsion

- from heel off to toe off
- supination of subtalar jt with heel lift
- locks forefoot against mid foot blocking the mud foot from buckling during propulsion
- with locking there is a reduction in muscle strain
- contraction of the peroneals to transfer weight to hallux
- this eversion of the foot from bearing weight laterally to medially transfers the weight of the limb to the contra lateral side
- hallux ROM needs to be 65º for normal propulsion to occur
- correct biomechanics will mean that stimulus is placed at the MT heads and therefore plantar flexors stimulated and the load is shared b/w MT heads & toes
- if however the skin beneath the med longitudinal arch is stimulated the flexors are inhibited and extensors switch on the risk to injury increases because the load now lies on the MT heads alone

swing phase

- b/w toe off and heel strike
- 1º BMX requirement is ground clearance and to position foot and ankle for heel strike
- this occurs via contraction of gastroc (knee flexor and ankle pl flexor) in early phase of propulsion and hip flexor contraction during late stance and early propulsion
- gastroc contraction allows the iliopsoas and hamstring to flex knee and the hip
- in late phase ant compartment mm i.e. tibialis ant prepares to dampen impact at heel strike. It also maintains dorsi flexion and inversion of the ankle and forefoot
- the pelvis drops a little on the swing side but is stabilized by the contraction of gluteus medius and minimus
- this contraction also rotates the pelvis forward swiveling it on the head of the femur. This aids the advance of the swing phase
- just prior to heel strike the foot is dorsiflexed, forefoot inverted, sub talar jt slightly supinated and an activation of dampening muscles

Injuries to the foot and lower limb

Patella tendonitis	calf strain
Iliotibial band syndrome	achilles rupture
Achilles tendonitis	compartment syndrome
Anterior lateral ligament sprain	shin splints/stress fractures
5^{th} MT base avulsion fracture	posterior tibialis tendonitis
plantar fascitis	hallux rigidis
collapsed transverse arch with MT head irritation	calcaneal fat pad irritation