BIOMECHANICS OF THE FOOT AND ANKLE

The foot has two vital functions:

- to support the weight of the body in standing or walking
- to act as a lever in propelling the body forward.

The vital function of the ankle joint is to allow the vertical excursion of the foot necessary for walking. Strong ligaments on each side of the ankle joint provide support and limit movement as needed.

The Gait Cycle

The gait cycle involves the following:

The centre of mass of the body moves in a vertical plane during the gait cycle.

Horizontal body displacements occur with each rotatory movement of the pelvis as a leg advances.

Lateral body displacements occur as the body is shifted slightly over the weight-bearing limb with each step.

The total lateral displacement of the body is approximately 5cm. from side to side with each gait cycle.

The weight bearing phase for each step is shown below:

- starts with heel strike
- proceeds to foot, flat
- then to heel, off
- then to toe, off.

The phases are repetitive; never changing.

Divided into 2 phases

The Stance phase, bearing weight [app. 62% of the gait cycle] and the Swing phase [app. 38% of the gait cycle] whilst advancing.
There is a progression of double limb support [the Stance Stage] followed by single limb support [the Swing Phase].

The axis of the ankle [a subtalar joint] is directed both laterally and posteriorly. It acts as a hinge, connecting the talus and calcaneus. Whenever the tibia rotates internally the subtalar ankle joint everts the calcaneus.

- then as the tibia externally rotates, the ankle inverts, causing the calcaneus to go into a varus position.


From heel strike to foot flat, the tibialis anterior contracts eccentrically, thus lengthening, while the gastroc soleus is quiescent.

During heel rise the gastroc soleus complex contracts concentrically and the tibialis is quiet.

The plantar aponeurosis originates on the plantar calcaneus and passes distally, inserting into the base of the flexor mechanism of the toes. It is a medial structure and functions as a windlass, increasing the arch as the toes dorsiflex during toe off.

The main inverter of the ankle during heel rise is posterior tibial tendon.

The Achilles tendon provides the motor attachment for the heel rise phase of gait.

The difference between running and the normal walking gait cycle is that at one point during the running cycle the person is airborne, (not bearing weight). This increases the force generated from approximately 11/2 times body weight to almost 3 times body weight.

Exam of Foot and Ankle

Observe gait. Antalgic or neuropathic pattern. Foot externally rotated to avoid push-off where pain; check medial arch.

Check alignment of limb (Flexion deformity hip, varus or valgus knee, varus or valgus heel, abducted/adducted forefoot). Look at patient from behind. Heel raise, toe raise, invert, evert (whilst standing).

Patient sits. You at their feet. Observe skin for scars, swelling, vascular problems, ulcers.

Document area of tenderness. Start from hindfoot, move to forefoot. Look at sole foot.

Ask patient to move ankle (Dorsiflex, plantarflex), you invert and evert heel, also abduct/adduct mid foot, patient dorsiflexes/plantarflexes toes; check for hallus/valgus.

Palpate pulses and check sensation.

Check tib ant (dorsiflex/invert) and tibia post (plantarflex/invert).
Special tests. Single leg heel raise step (Johnson, to assess function tib. post); Coleman’s block test (assess varus posture heel). Perform Tinel’s test.

Measure mid-foot and mid-calf diameters.

ADULT DISORDERS of THE FOOT and ANKLE

A) Fractures and Dislocations of the Foot
B) Fractures and Dislocations of the Ankle
C) Diabetic Foot
D) Infections of the Foot and Ankle
E) Amputations of the Foot and Ankle
F) Postural Disorders in Adults
G) Neurologic Disorders
H) Adult Hallux Valgus
I) Lesser Toe Deformities
J) Sesamoids and Accessory Bones
K) Hyperkeratotic Pathology of the Plantar Foot
L) Arthritic Disease
M) Tendon Disorders
N) Heel Pain
O) Soft Tissue Trauma and Compartment Syndromes
P) Ankle Sprains
Q) Toenail Pathology

FRACTURES and DISLOCATIONS of the FOOT.

The major fractures and dislocations
Calcaneus Fractures
Talus Fractures
Metatarsal Fractures
Subtalar Dislocations
Lisfranc’s Joint Injury

A brief review.

Calcaneal Fractures

Evaluation needs to be with x-rays; measure. Böhler’s angle and the angle of Gissane (--------) a C.T. scan in two planes (if surgical intervention is planned).

Symptoms include severe pain, inability to stand, oedema, and discolouration.

Treatment varies depending on the fractures. Fractures of the Sustentaculum Tali and extra-anticular fractures usually respond well to temporary immobilisation and / or strapping. The anterior proce