## Feet, Footwear and Falls

Is the correlation really that simple?

## Primary Role of Footwear

- Protect the foot
- Facilitate propulsion
- Provide feedback to the foot and ankle
- Modify frictional conditions of floor interfaces
- Reinforce a personal identity (even though it may compromise the natural functioning of the foot)

## Contributing factors to falls

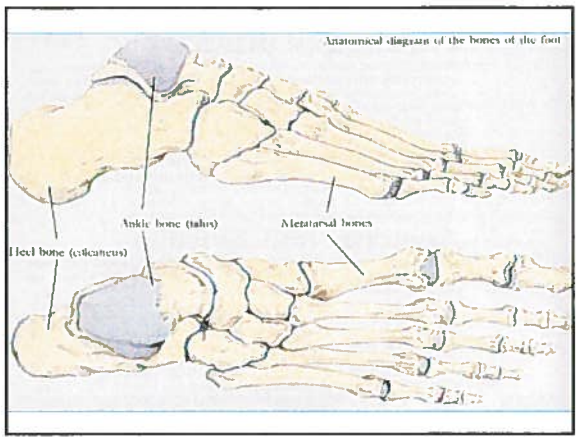
- Age related deterioration of the balance and neuromuscular systems, changes also including the structure and function of the foot
- Most occur during motor tasks therefore footwear can be an environmental risk factor
- Older people should wear shoes with low heels and firm slip resistant soles

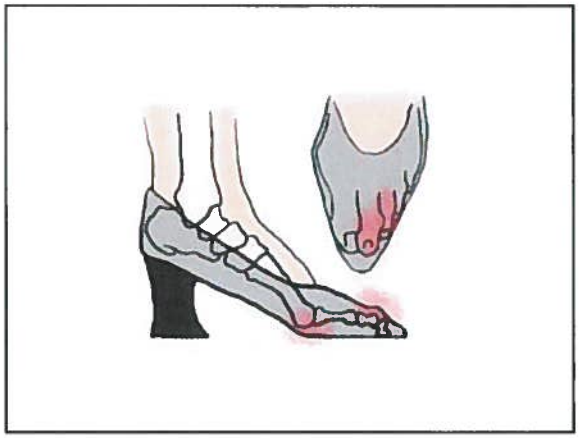
## Is it that simple?

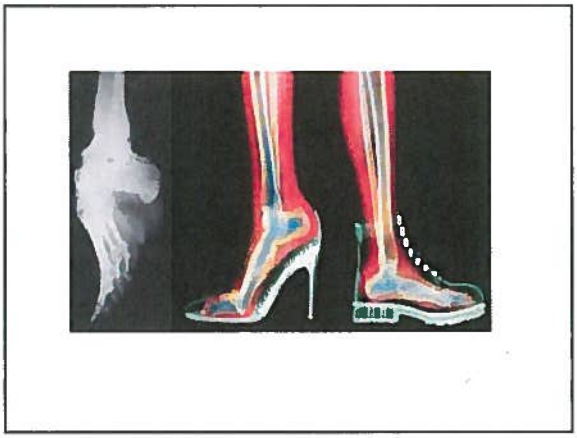
## Goals of Presentation

- Review of simple foot arthrokinematics
- Footwear- principles of design as related to gait
- Problem solving opportunities to directly address foot dysfunction by shoe prescription
- Insightful answers to outstanding learning needs

## Retirement home issue

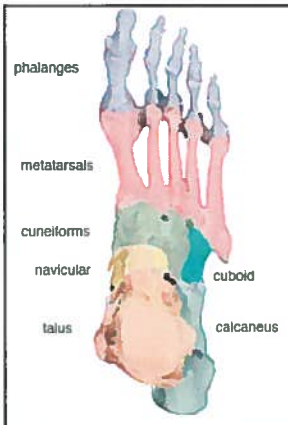




## Foot Facts

- 26 Bones; 33 Joints; 107 Ligaments; 19 Muscles
- Woman have 4X as many foot problems
- Many conditions first exhibit symptoms in the feet (arthritis, nerve & circulatory disorders, diabetes etc.)
- Running causes pressure = 3 to 4 times body weight




**THINK FUNCTIONAL**

Forefoot,
Midfoot,
Rearfoot

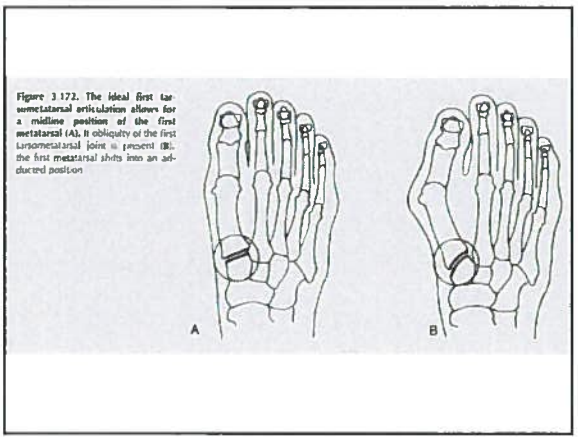
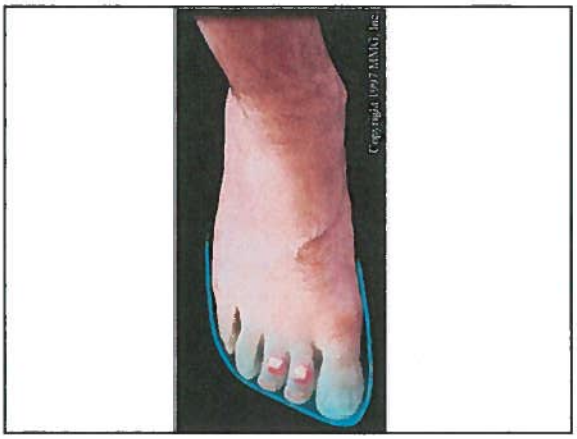
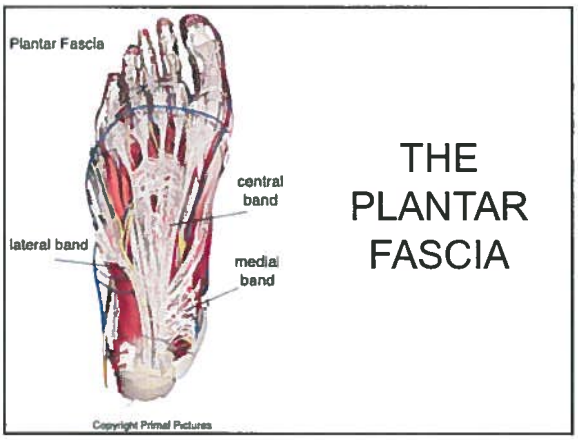
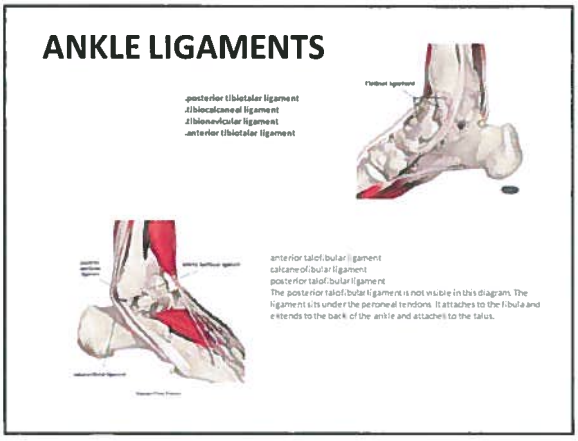


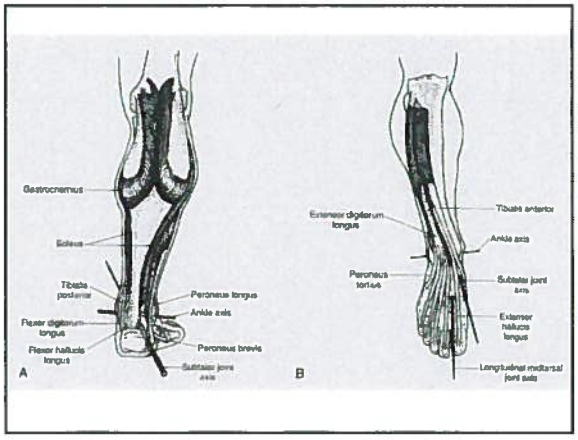
Figure 3.172. The ideal first tarsometatarsal articulation allows for a midline position of the first metatarsal (A). If obliquity of the first tarsometatarsal joint is present (B), the first metatarsal shifts into an adducted position
A
B




Plantar Fascia
central band
lateral band
medial band
THE PLANTAR FASCIA
Copyright Primal Pictures


Some things need professional help


ANKLE LIGAMENTS
posterior tibiotalar ligament
tibiocalcaneal ligament
tibionavicular ligament
anterior tibiotalar ligament
anterior talofibular ligament
calcaneofibular ligament
posterior talofibular ligament
The posterior talofibular ligament is not visible in this diagram. The ligament sits under the peroneal tendons. It attaches to the fibula and extends to the back of the ankle and attaches to the talus.


Gastrocnemius
Soleus
Tibialis posterior
Flexor digitorum longus
Flexor hallucis longus
Peroneus longus
Ankle axis
Peroneus brevis
Subtalar joint axis
A
Extensor digitorum longus
Tibialis anterior
Ankle axis
Peroneus tertius
Subtalar joint axis
Extensor hallucis longus
B

What two prime functions does the foot provide?

**For normal gait:**

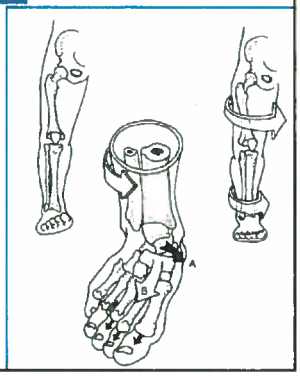
- The foot must be a mobile adaptor (shock absorber)
- The foot must act as a rigid lever (propulsion)

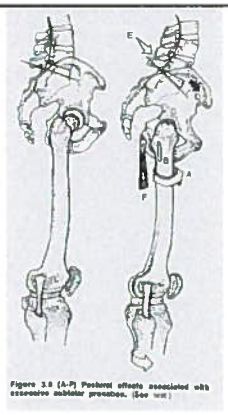
## PRONATION & SUPINATION

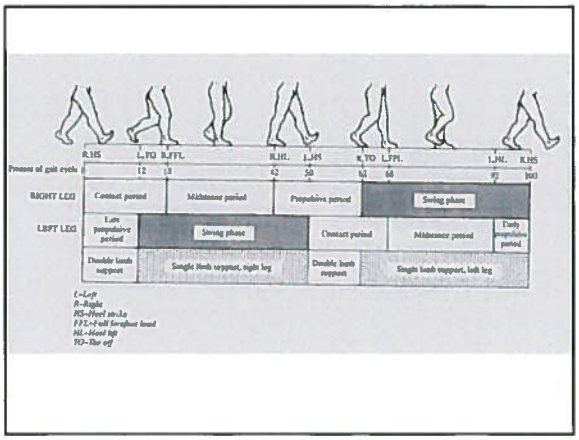
| SUBTALAR PRONATION | SUBTALAR SUPINATION |
|---|---|
| • Shock Absorption | • Enables foot to act as rigid lever |
| • Rotational Absorption of lower limbs | • Provides a solid base of support |
| • Enables adaptation to loose terrain | |

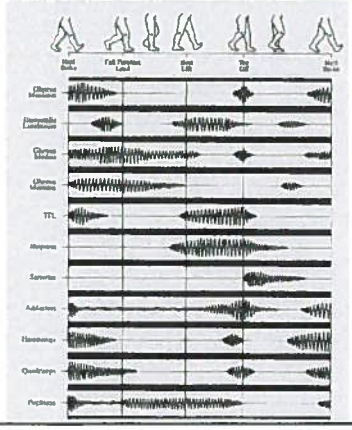
# EXERCISE

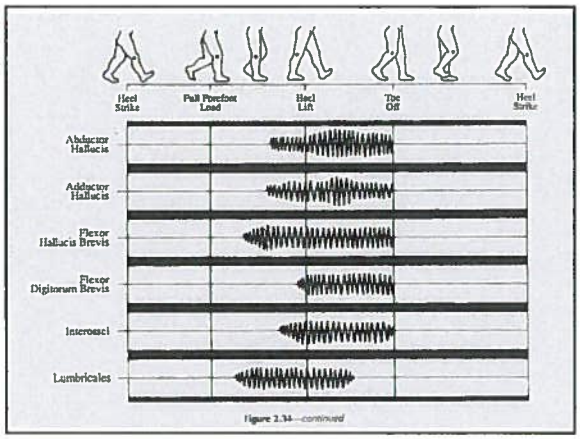
**Effect Of Excessive Pronation On The Kinetic Chain**

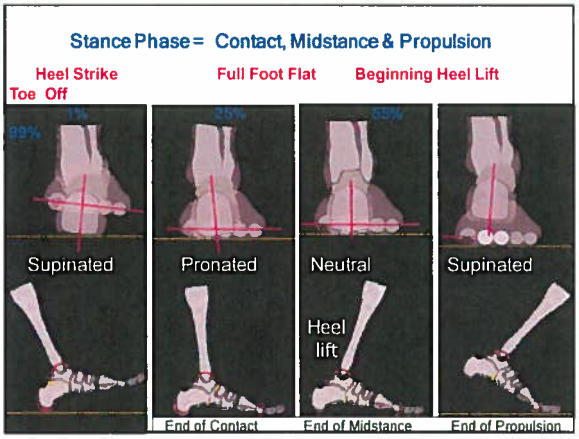


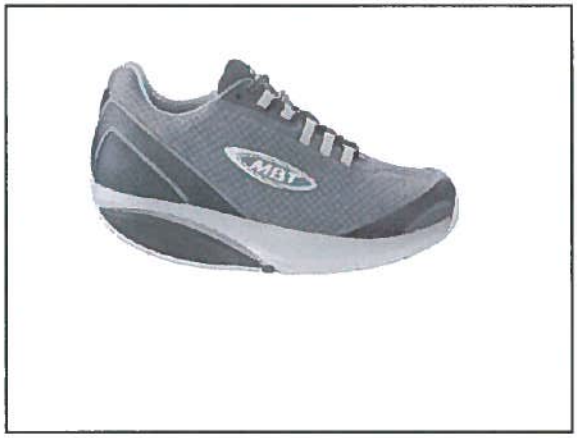




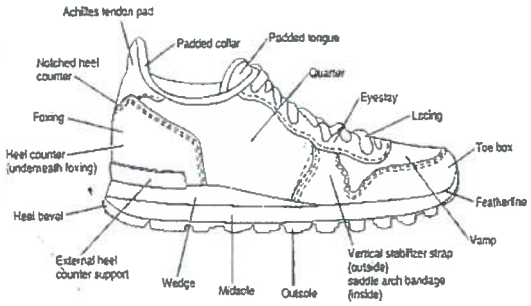




Heel Strike
Full Forefoot Load
Heel Lift
Toe Off
Heel Strike
Abductor Hallucis
Adductor Hallucis
Flexor Hallucis Brevis
Flexor Digitorum Brevis
Interossei
Lumbricales

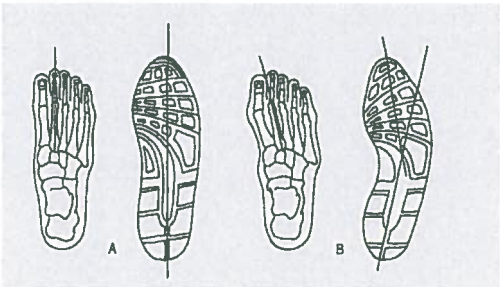

Stance Phase = Contact, Midstance & Propulsion
Heel Strike
Toe Off
Full Foot Flat
Beginning Heel Lift
1%
99%
25%
65%
Supinated
Pronated
Neutral
Heel lift
Supinated
End of Contact
End of Midstance
End of Propulsion


MBT

What about footwear?



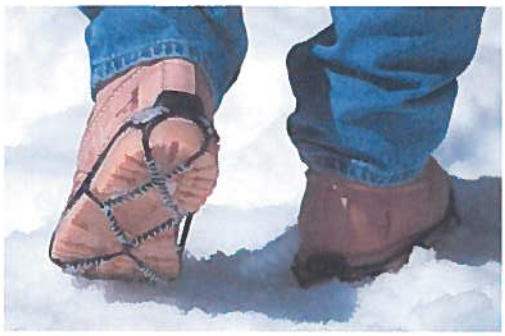

Running Shoe




Consider the foot shape, consider the last shape

Dansko, P.W. Minor, New Balance

Pedors shoe – stretchable uppers, crepe sole



Yak trax shoes

Neos - go over footwear

## Purposeful Goals

- To be able to impact on a clients fall prevention program need to consider several factors including
- Foot types and joint dysfunction
- Watch them walk/ gait analysis
- Review their footwear and the donning and doffing practices ☺
- Realistic goal setting

## Other interventions

- Muscle imbalance-stretches, strengthening
- Balance retraining
- Pain management-ice/heat
- Body mechanics awareness
- Foot offloading principles
- Review all current footwear

# Flexibility

The Arthritis Society

PM31-M37

## Foot and Ankle Characteristics Associated With Impaired Balance and Functional Ability in Older People

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**Abstract**

**Background.** Ageing is associated with changes to the structure and function of the foot and ankle, and there is preliminary evidence that foot problems impair balance and increase the risk of falls. To explore this in more detail, we conducted a study to determine the relative contribution of several foot and ankle characteristics to performance on a range of balance and functional tests.

**Methods.** One hundred seventy-six people (56 men and 120 women, mean age 80.1 years, standard deviation 6.4 years) residing in a retirement village underwent tests of foot and ankle characteristics (including foot posture, range of motion, strength, and deformity), sensorimotor function (including vision, sensation, strength, and reaction time), and balance and functional ability (including tests of standing balance, tandem balance, stepping, sit-to-stand, and walking speed).

**Results.** Many foot and ankle characteristics and sensorimotor measures were associated with performance on the balance and functional tests in univariate analyses. Multiple regression analysis consistently revealed that ankle flexibility, plantar tactile sensation, and toe plantarflexor strength were significant and independent predictors of balance and functional test performance, explaining up to 59% of the variance in these test scores.

**Conclusions.** Foot and ankle characteristics, particularly ankle flexibility, plantar tactile sensation, and strength of toe plantarflexor muscles, are significant independent predictors of balance and functional ability in older people. Programs to improve the strength and flexibility of the foot and interventions to augment plantar sensation may be beneficial in improving mobility and reducing the

## Footwear and Falls Prevention

Is it really just about the shoe?

***Conclusions.*** Foot and ankle characteristics, particularly ankle flexibility, plantar tactile sensation, and strength of toe plantarflexor muscles, are significant independent predictors of balance and functional ability in older people. Programs to improve the strength and flexibility of the foot and interventions to augment plantar sensation may be beneficial in improving mobility and reducing the risk of falls.

## Thank You

**Features of Orthopaedic Footwear**

1. removable sock liner / insert to accommodate prescribed orthotic devices.
2. a minimum of 5 mm (3/16) for women or 8 mm (5/16) for additional depth for men, in the shoe last.
3. manufactured with a variety of 3 or more widths, graded and sized to a recognized measuring / sizing standard and device.
4. adjustable closure (ie. Laces, Velcro) to secure hind-foot position inside the shoe.
5. a smooth protective inner lining
6. broad insole and last patterns that entirely accommodate the anatomy of a foot.
7. sufficient torsional stability through out the sole.
8. heel stability via a firm and / or extended heel counter.
9. an outer sole that is equal to, or exceeds the width of the upper.
10. an outer sole with sufficient toe spring roll to promote normal gait cycle.
11. a shoe that is conducive to permanent modification (s).