

# What Does The Plantar Aponeurosis Do?

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# The Plantar Aponeurosis

- Anatomy
- Function
- Clinical relevance
- Clinical tests of function

# Anatomy



# Anatomy





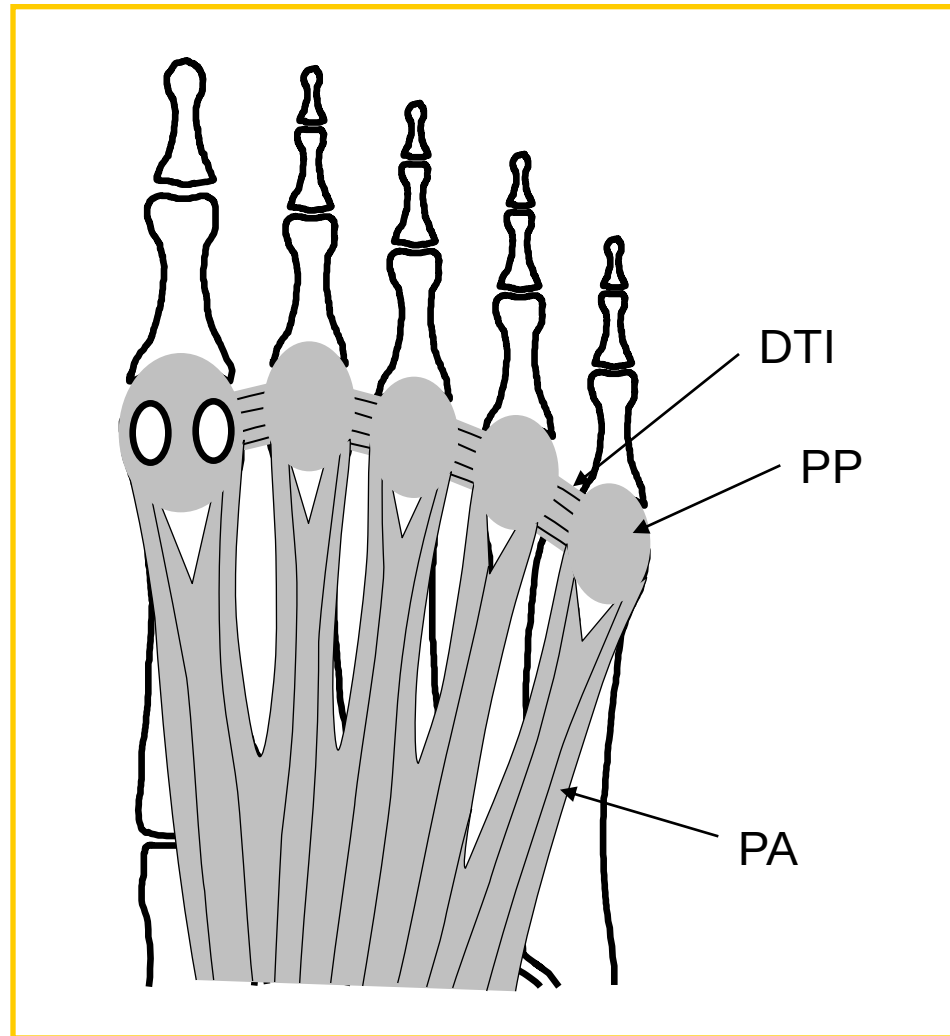
# Anatomy



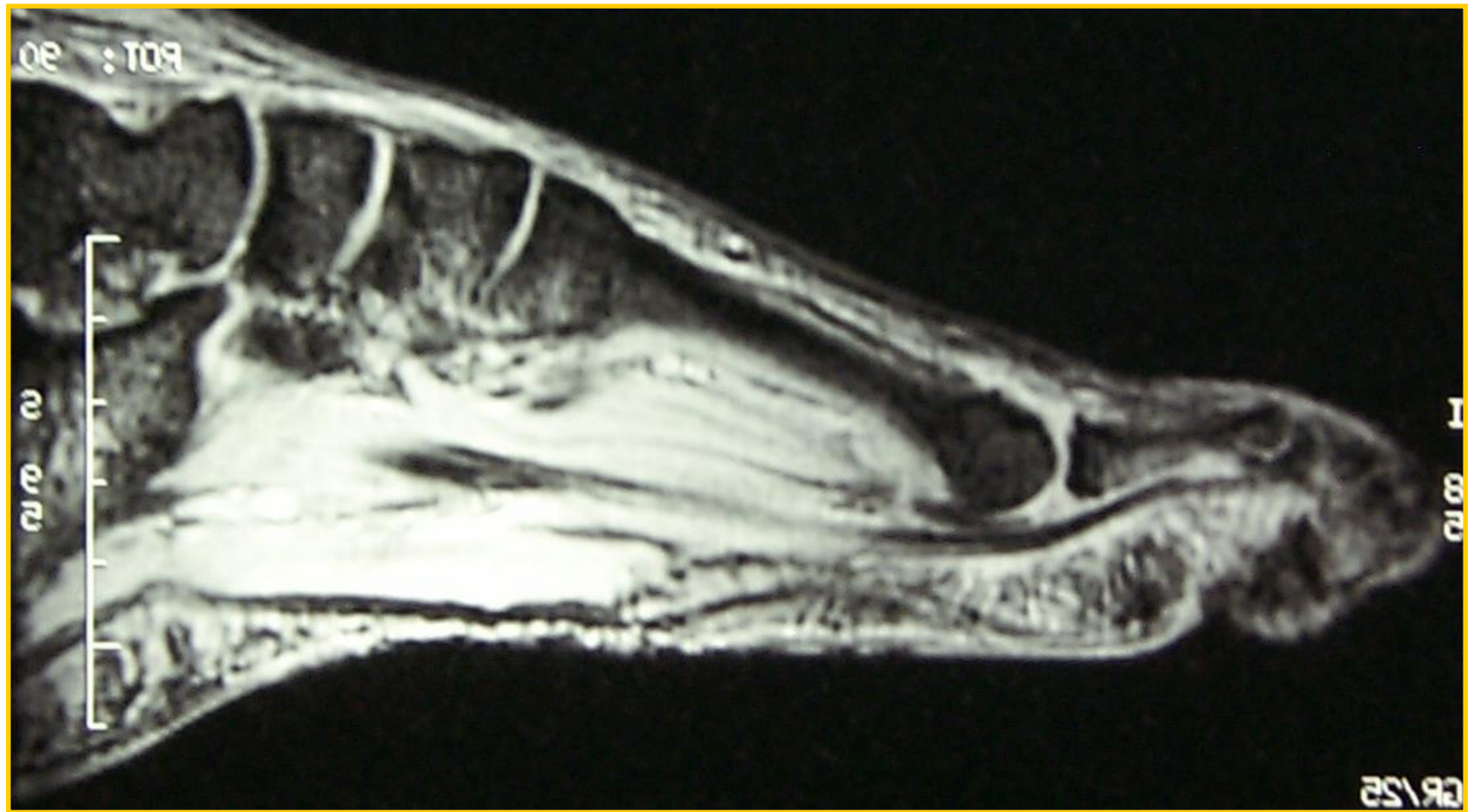
# Anatomy



# Anatomy

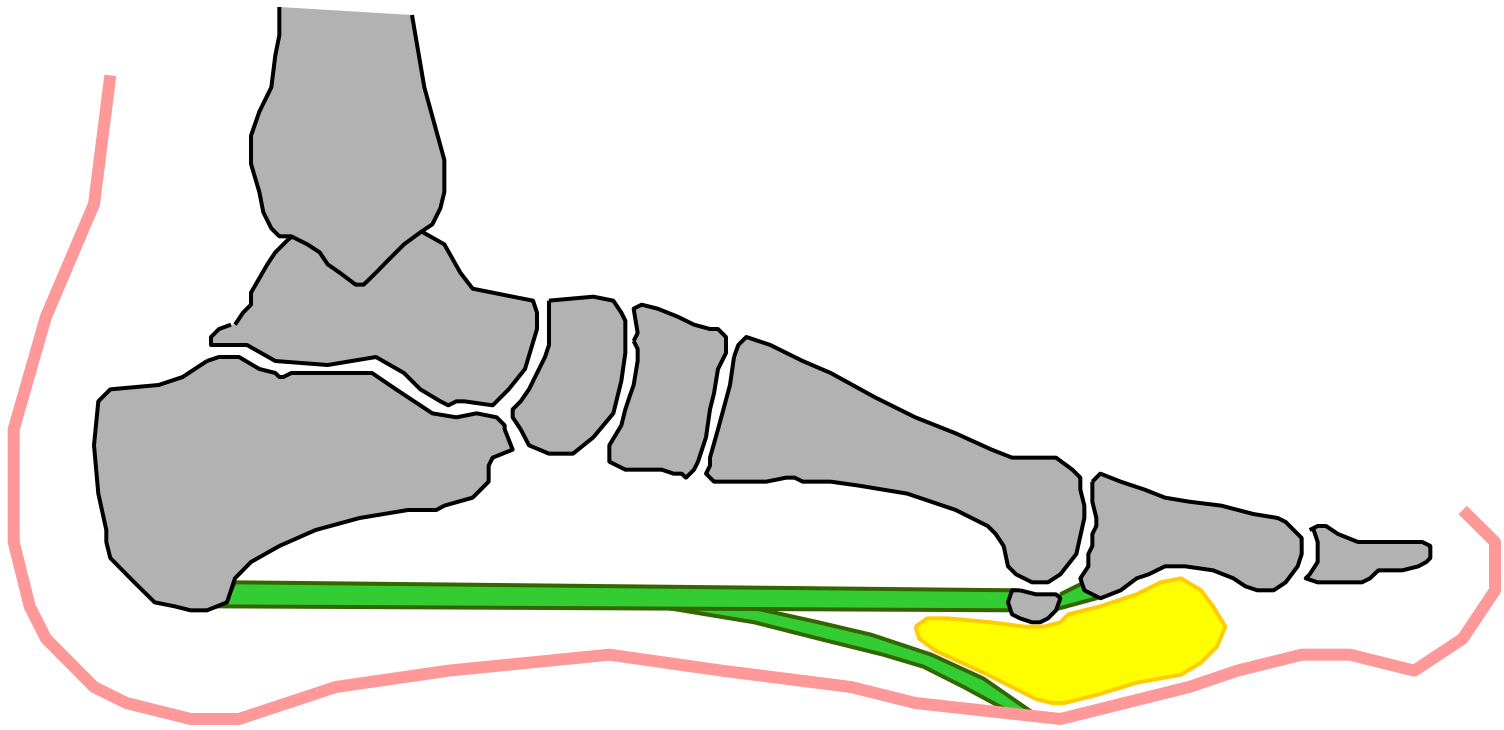


# Anatomy





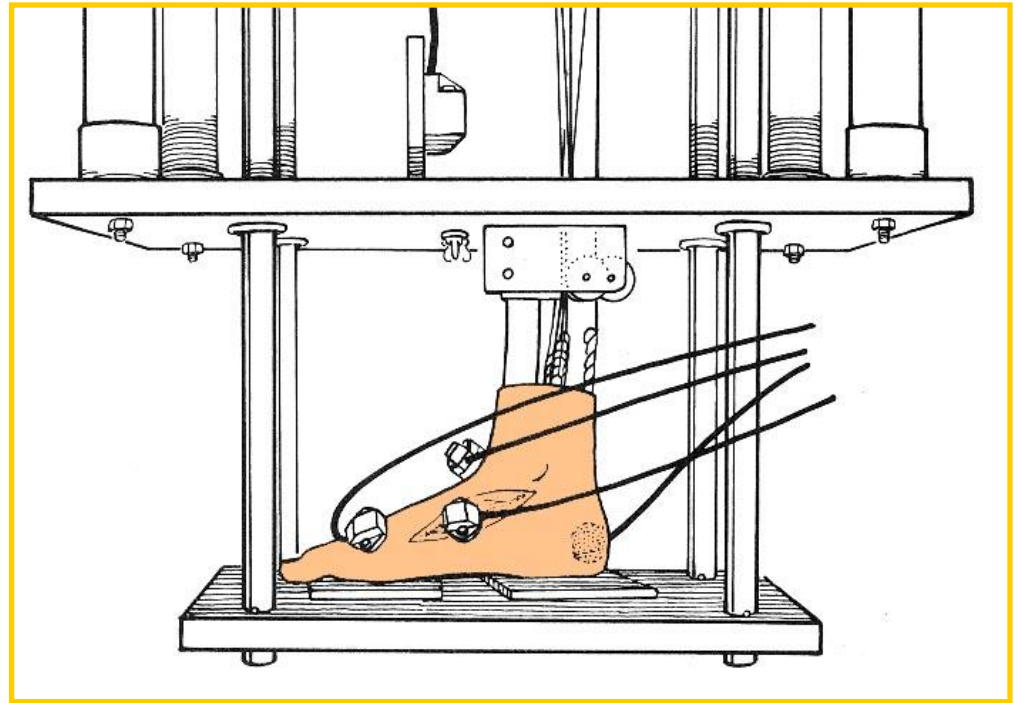
# Anatomy



# What Does the Plantar Aponeurosis Do?

- ?
- 
- 
-

# Arch Support



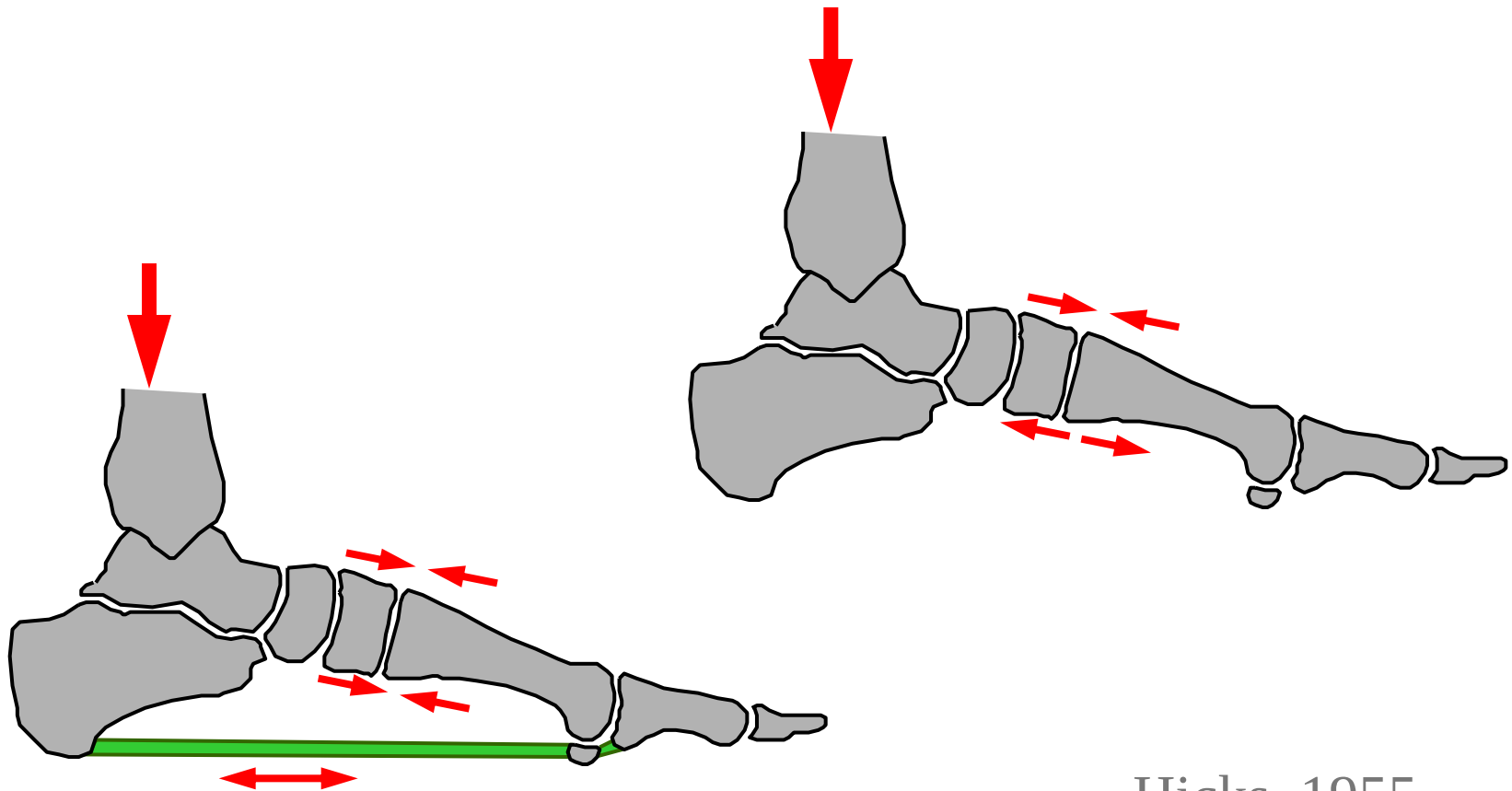
- Plantar aponeurosis 25%
- Long and short plantar ligaments 10%
- Spring ligament 10%
- Residual stiffness 63%

Huang et al, 1993





# Arch Support



Hicks, 1955  
Sharkey, 1999

# What Does the Plantar Aponeurosis Do?

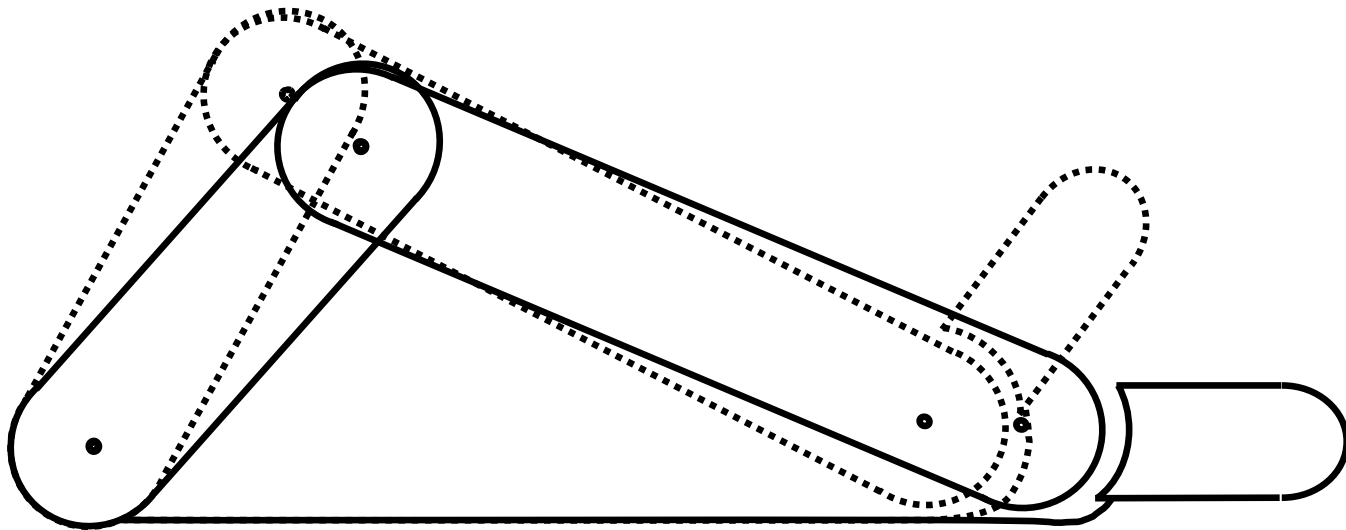
- Arch Support
- ?
- 
-

# Control of Foot Shape

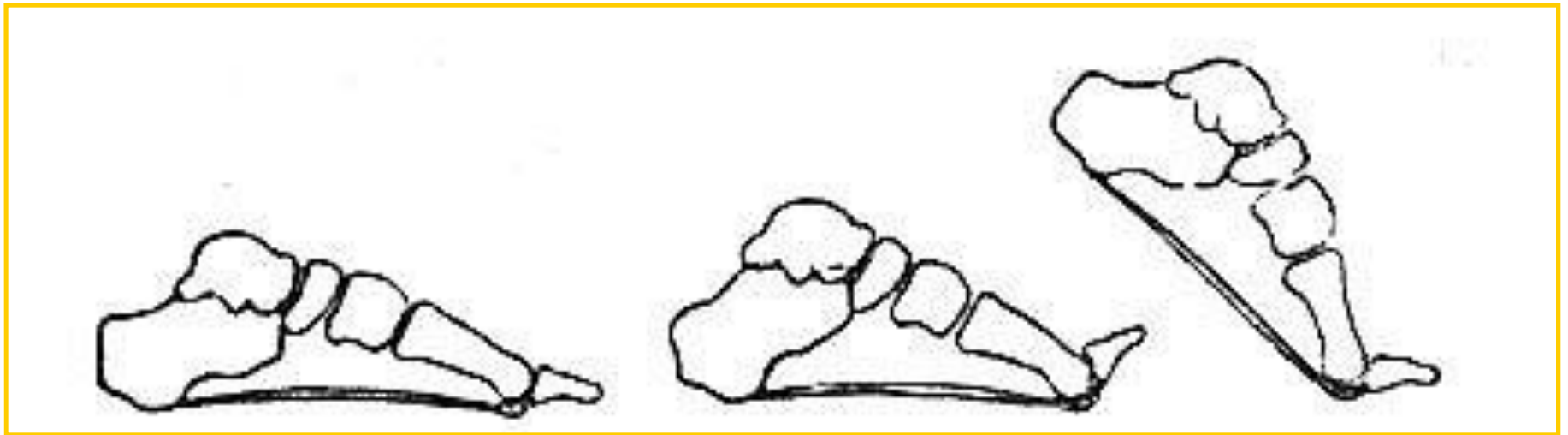
- Toe extension test



# Windlass Mechanism



# Windlass Mechanism



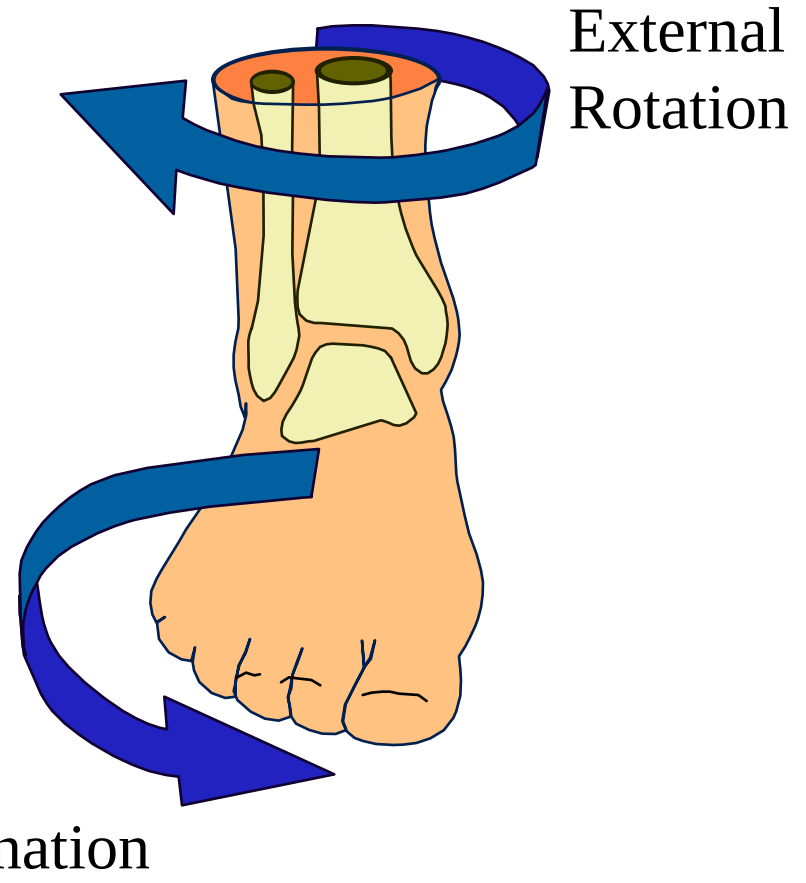
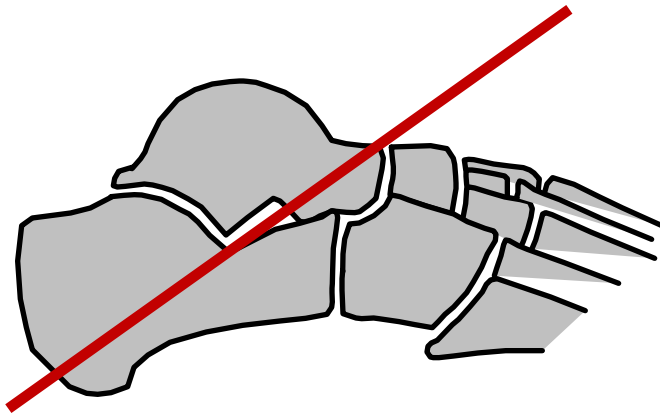


# Windlass Mechanism

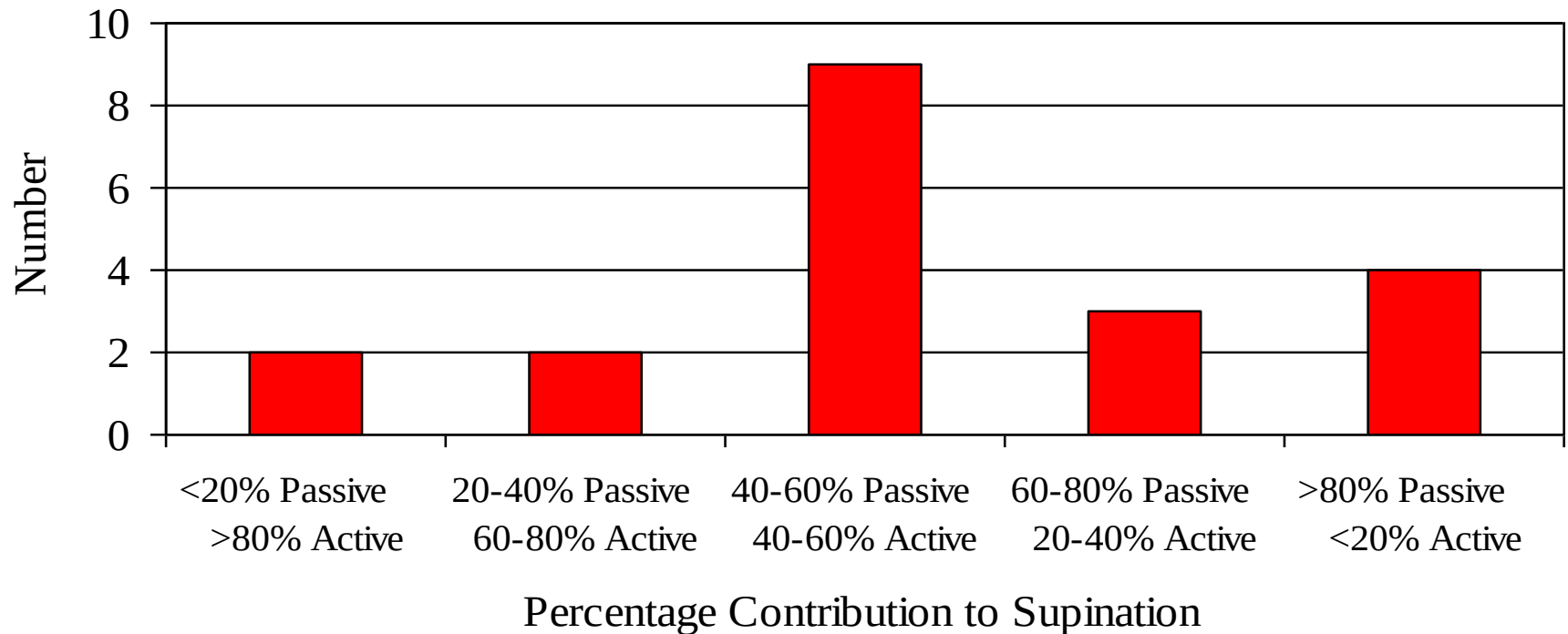


# Windlass Mechanism

- Limb rotation



# Active and Passive Mechanisms in Heel Supination

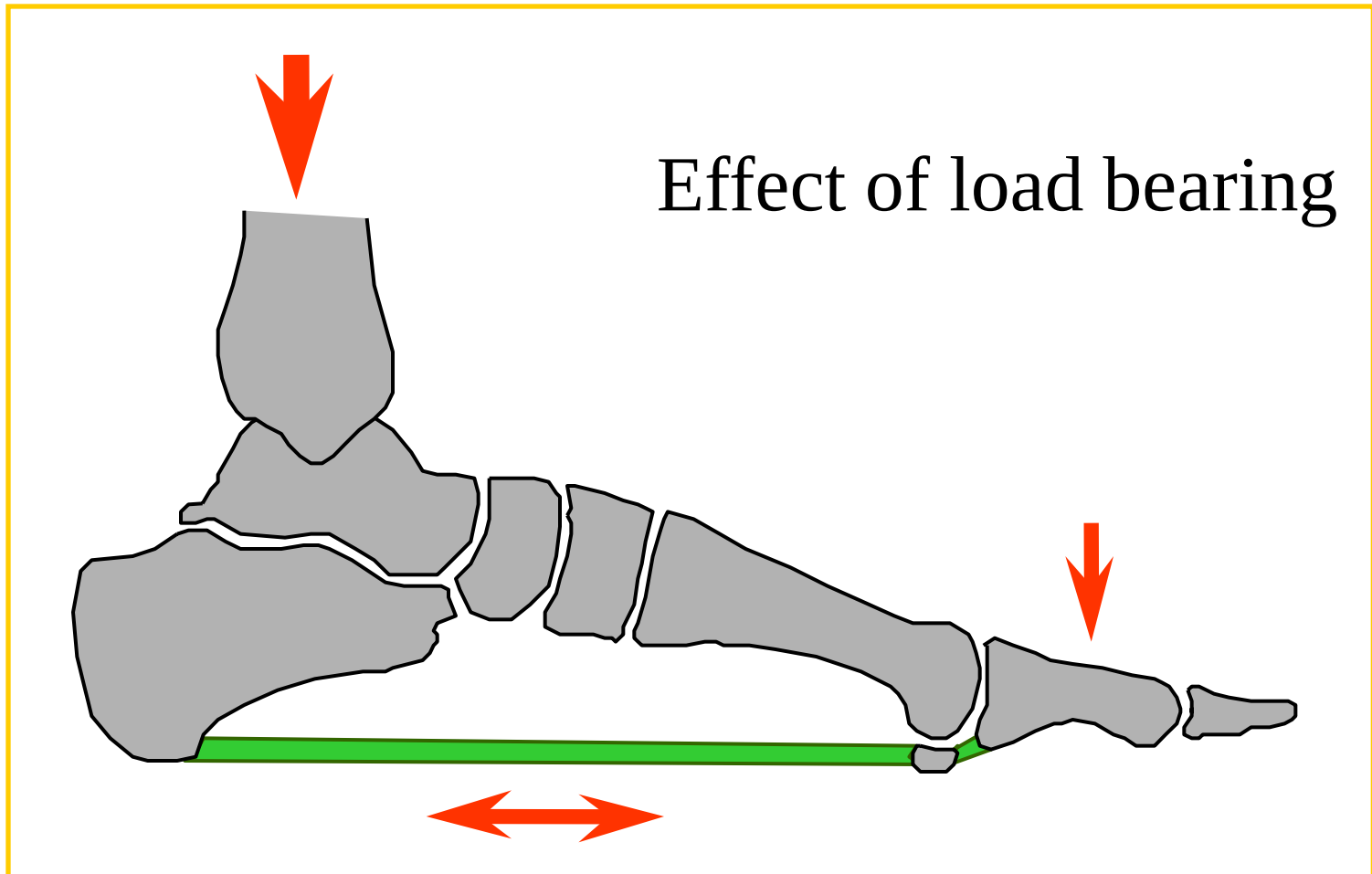


Tansey and Briggs, 2001

# What Does the Plantar Aponeurosis Do?

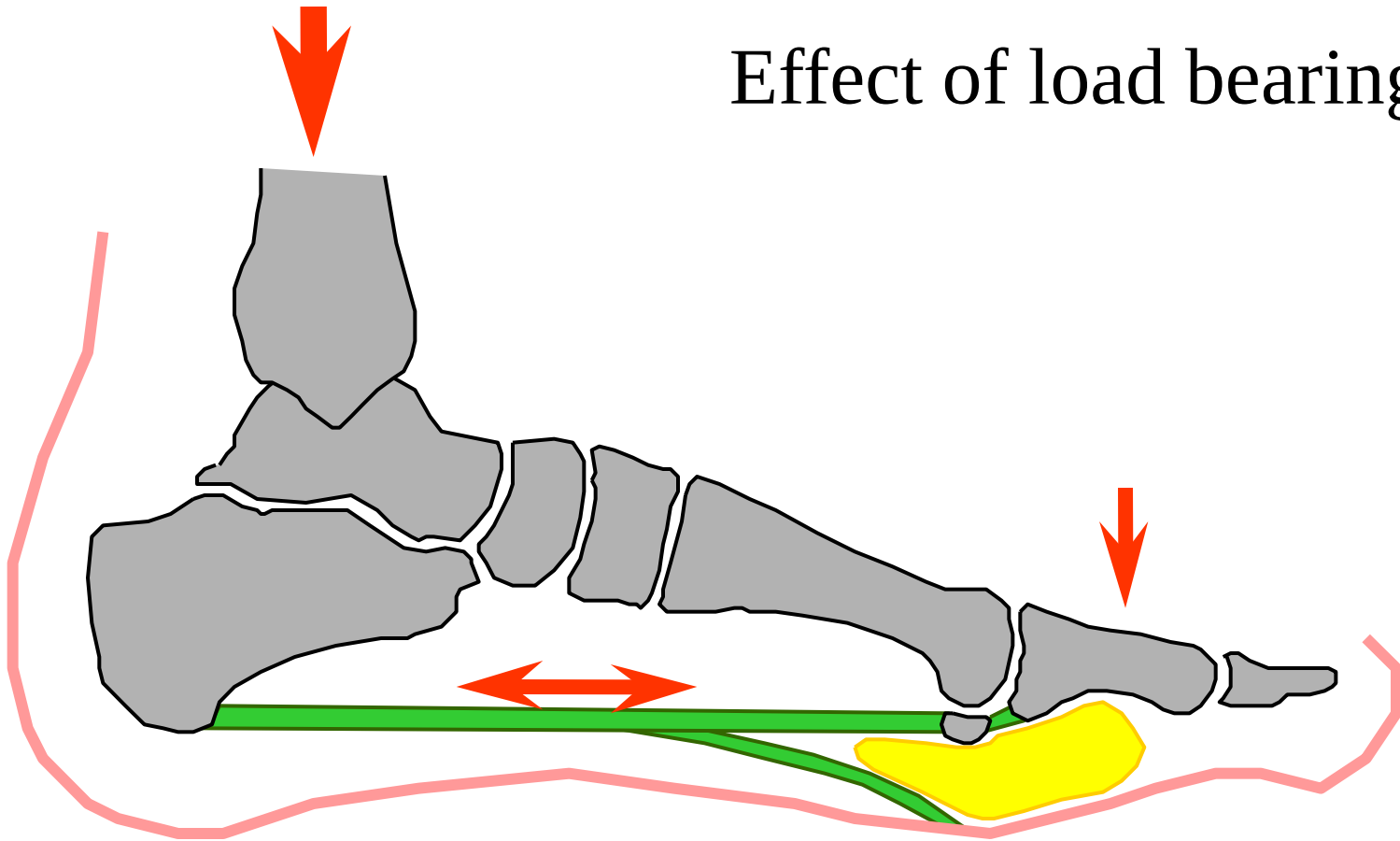
- Arch support
- Control of foot shape and limb rotation
- ?
-

# Toe Flexion



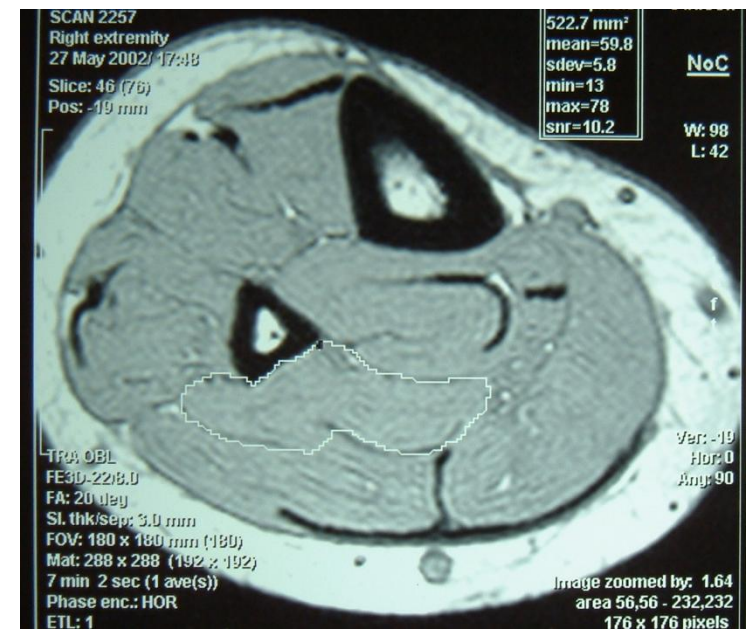
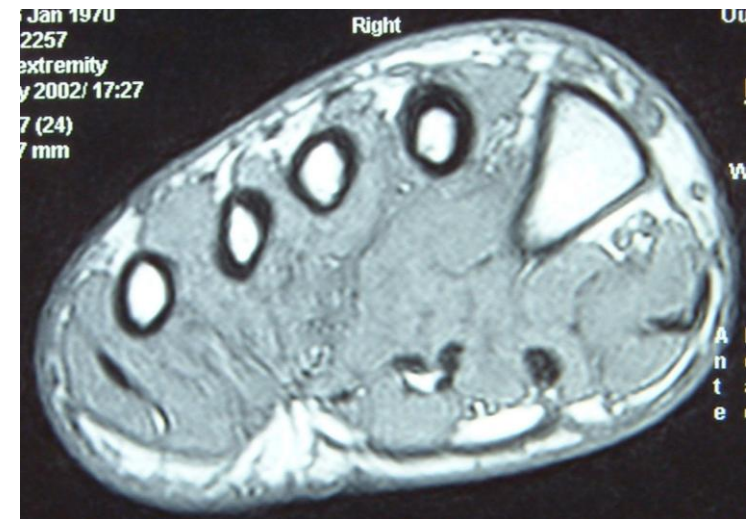
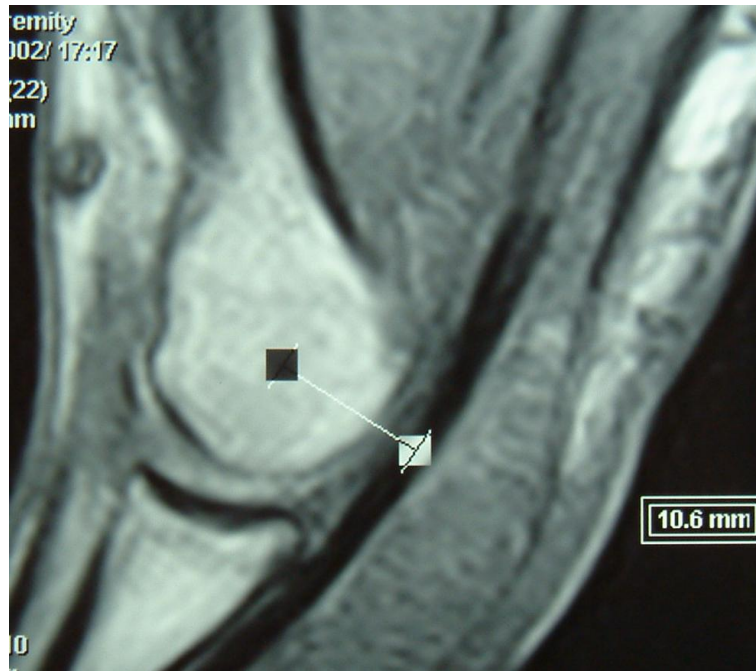
# Fat Pad Compression

Effect of load bearing





# Muscle Strength



# Toe Flexion Moments

| Muscle Group | Flexion moment of force (Nm) |        |      |
|--------------|------------------------------|--------|------|
|              | MTP1                         | MTP2-4 | MTP5 |
| Medial       | 1.05                         |        |      |
| Adductor     | 1.39                         |        |      |
| Central      |                              | 0.63   |      |
| Interosseous |                              | 1.24   |      |
| Lateral      |                              |        | 0.47 |
| FHL          | 1.83                         |        |      |
| FDL          |                              | 1.19   |      |
| Total        | 4.27                         | 3.06   | 0.47 |

Green and Briggs, unpublished data

# Toe Flexion Moments

|                              | Hallux | Lesser Toes |
|------------------------------|--------|-------------|
| Actual Flexion Force         | 7.74   | 1.50 – 1.63 |
| Maximal Muscle Flexion Force | 4.27   | 0.47 – 1.02 |
| Percent                      | 55%    | 31 – 63%    |

Green and Briggs, unpublished data

# Plantar Aponeurosis Tension

- Maximal at late stance
- 96% 36% body weight
- Correlates with Achilles tendon tension
- PA Division:
  - 50% reduction of hallux loading
  - 60-70% reduction of lesser toe loading

Erdemir et al, 2004

Sharkey et al, 1999

# What Does the Plantar Aponeurosis Do?

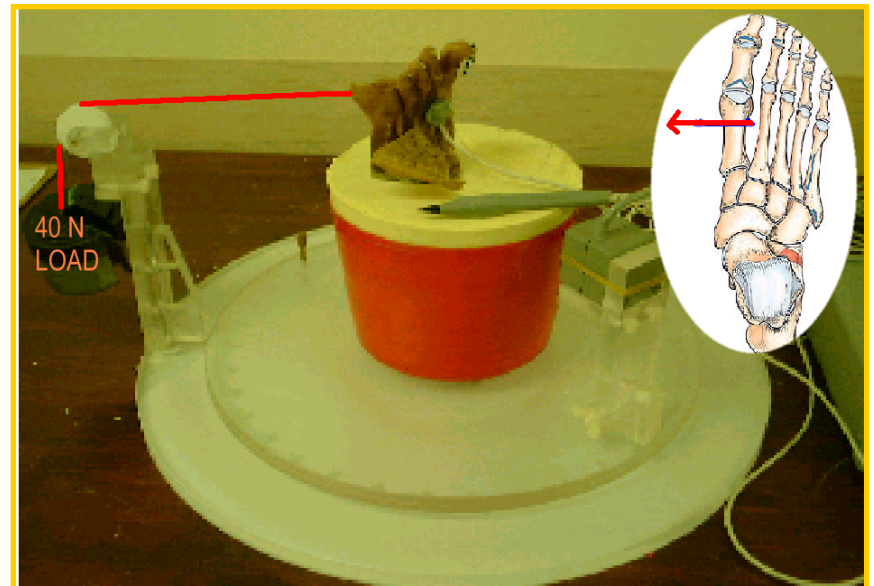
- Arch support
- Control of foot shape and limb rotation
- Flexion of the toe MTP joints
- ?

# 1<sup>st</sup> Metatarsal Stability

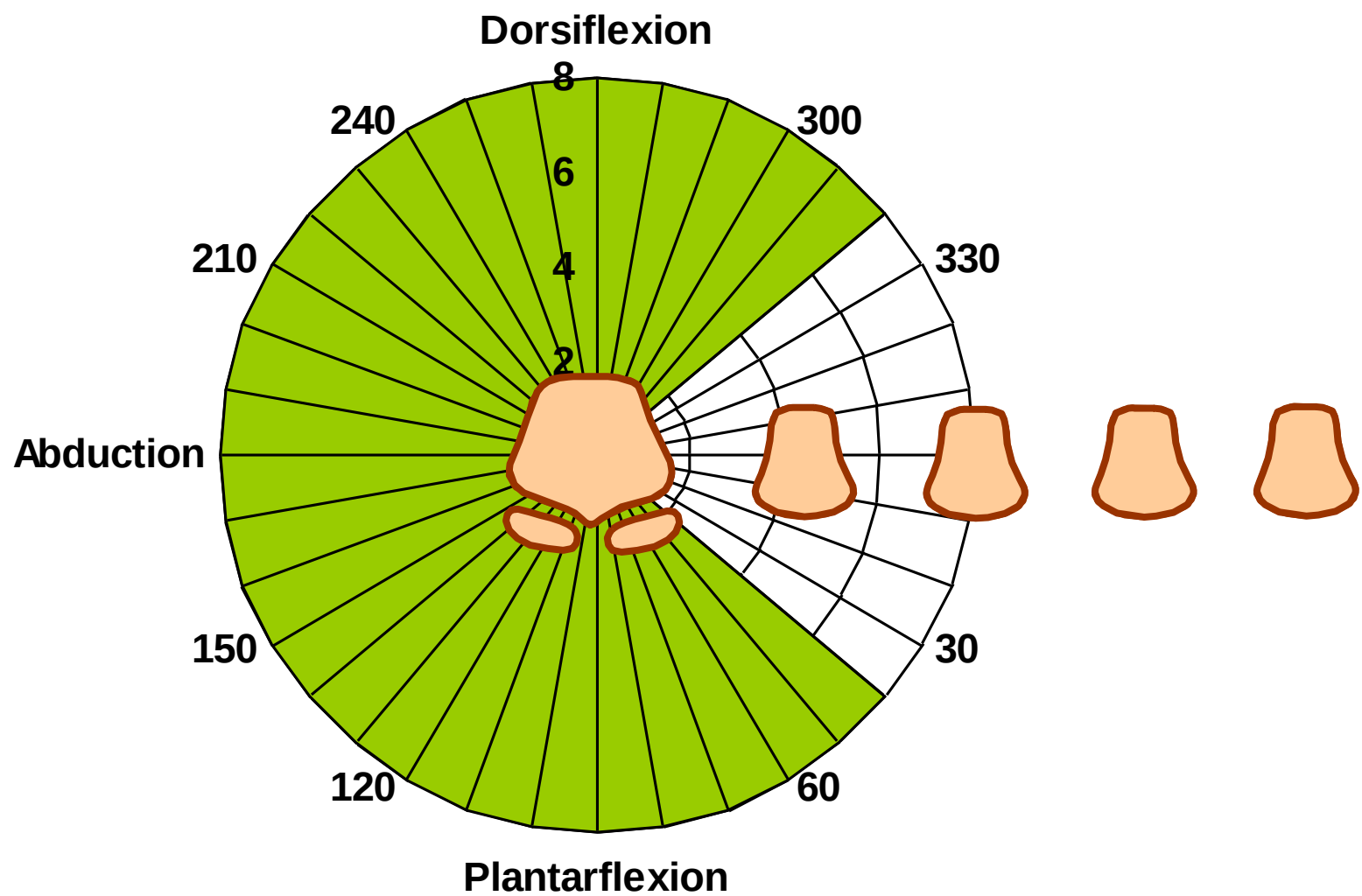


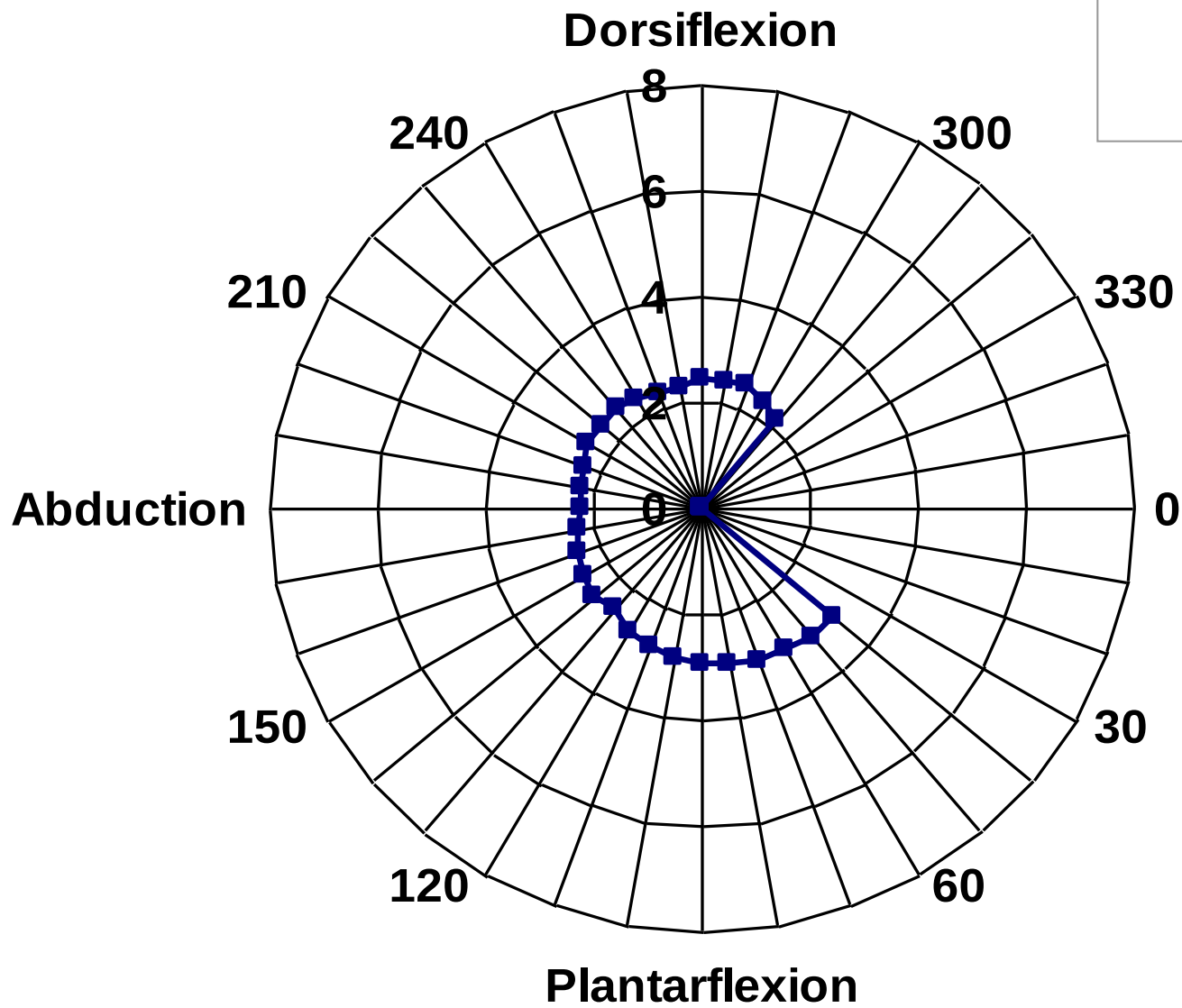
# Methods

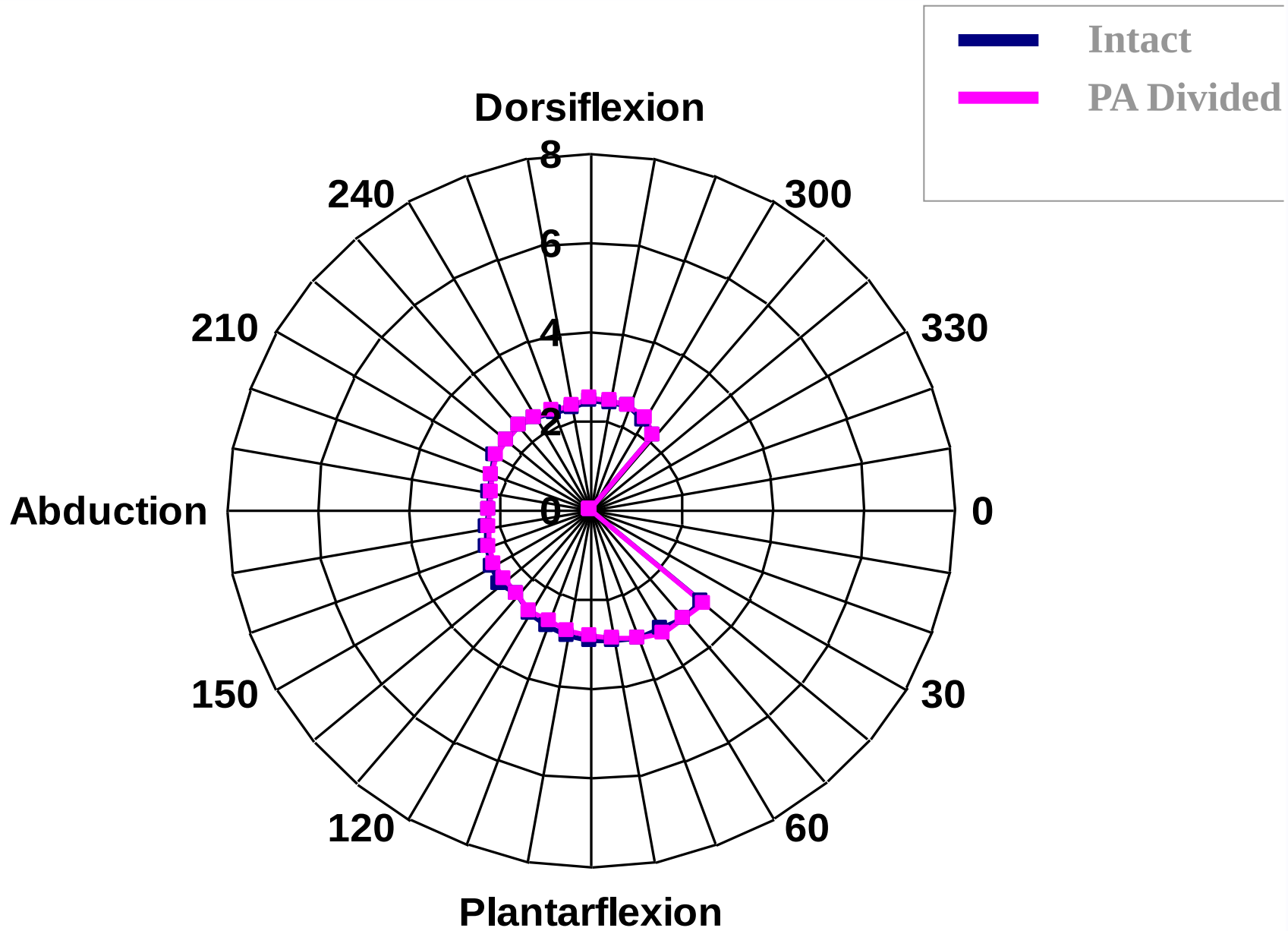
- Mounted
- Rotating test rig
- Loads applied to 1<sup>st</sup> metatarsal
  - Plantar flexion
  - Abduction
  - Dorsiflexion

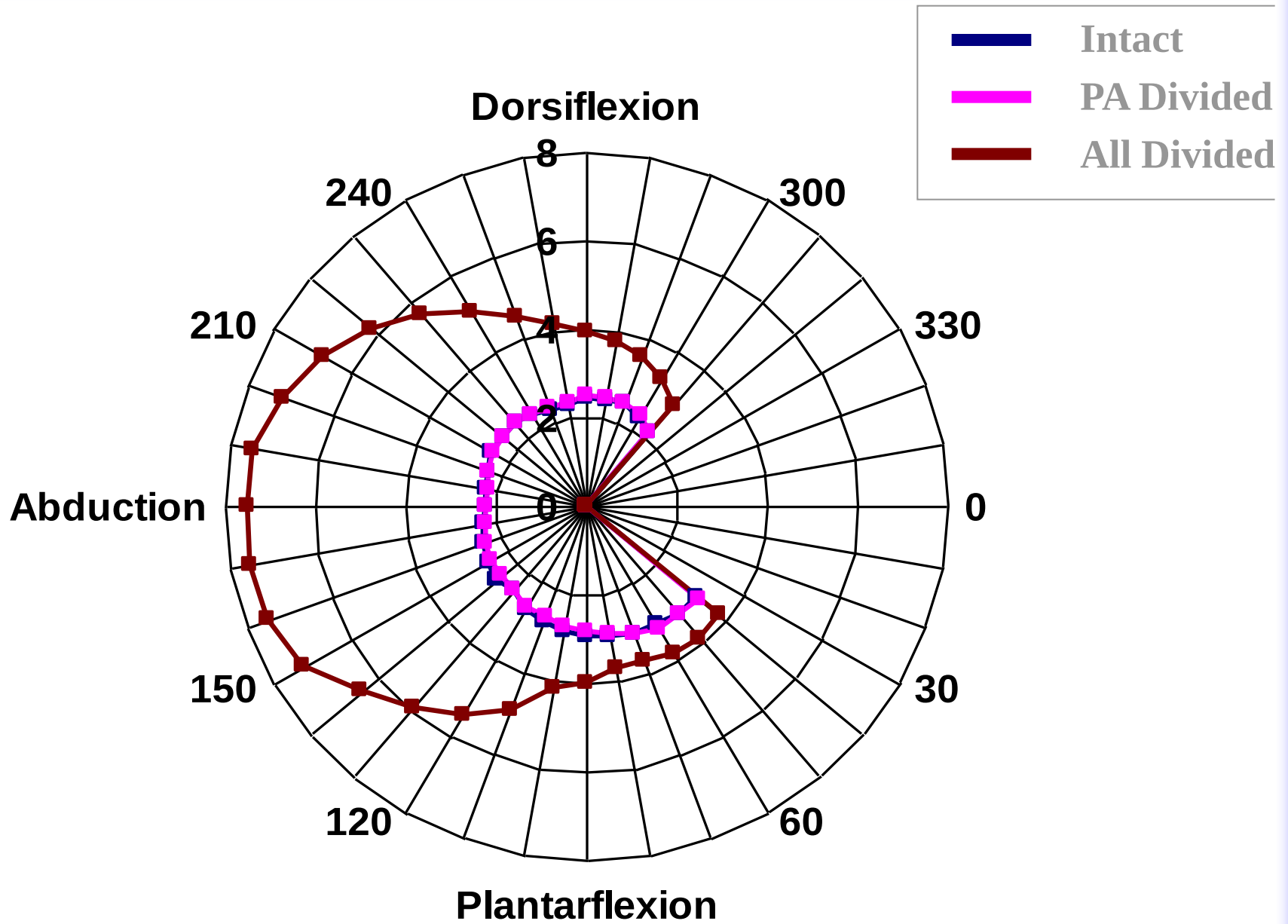




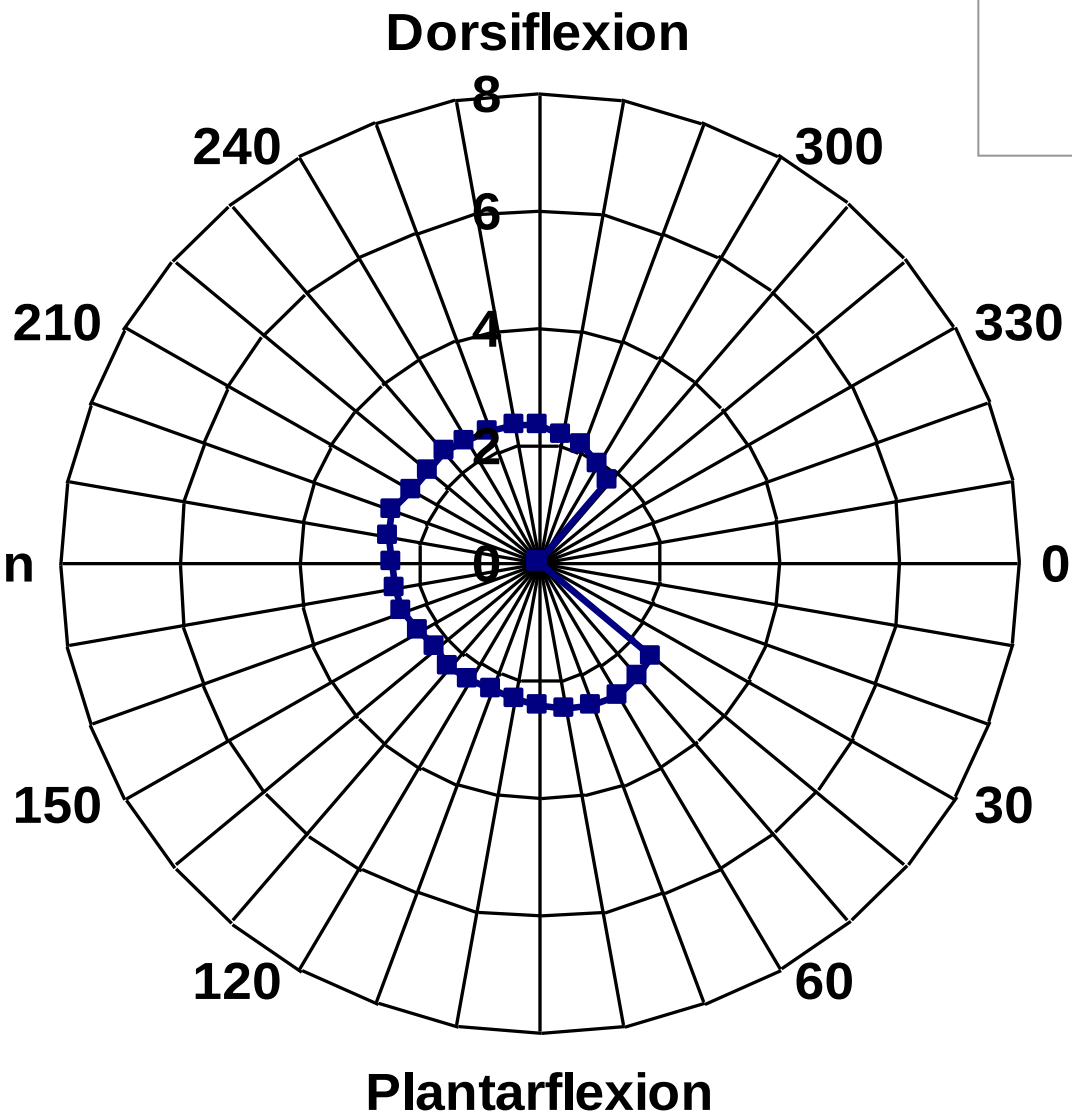


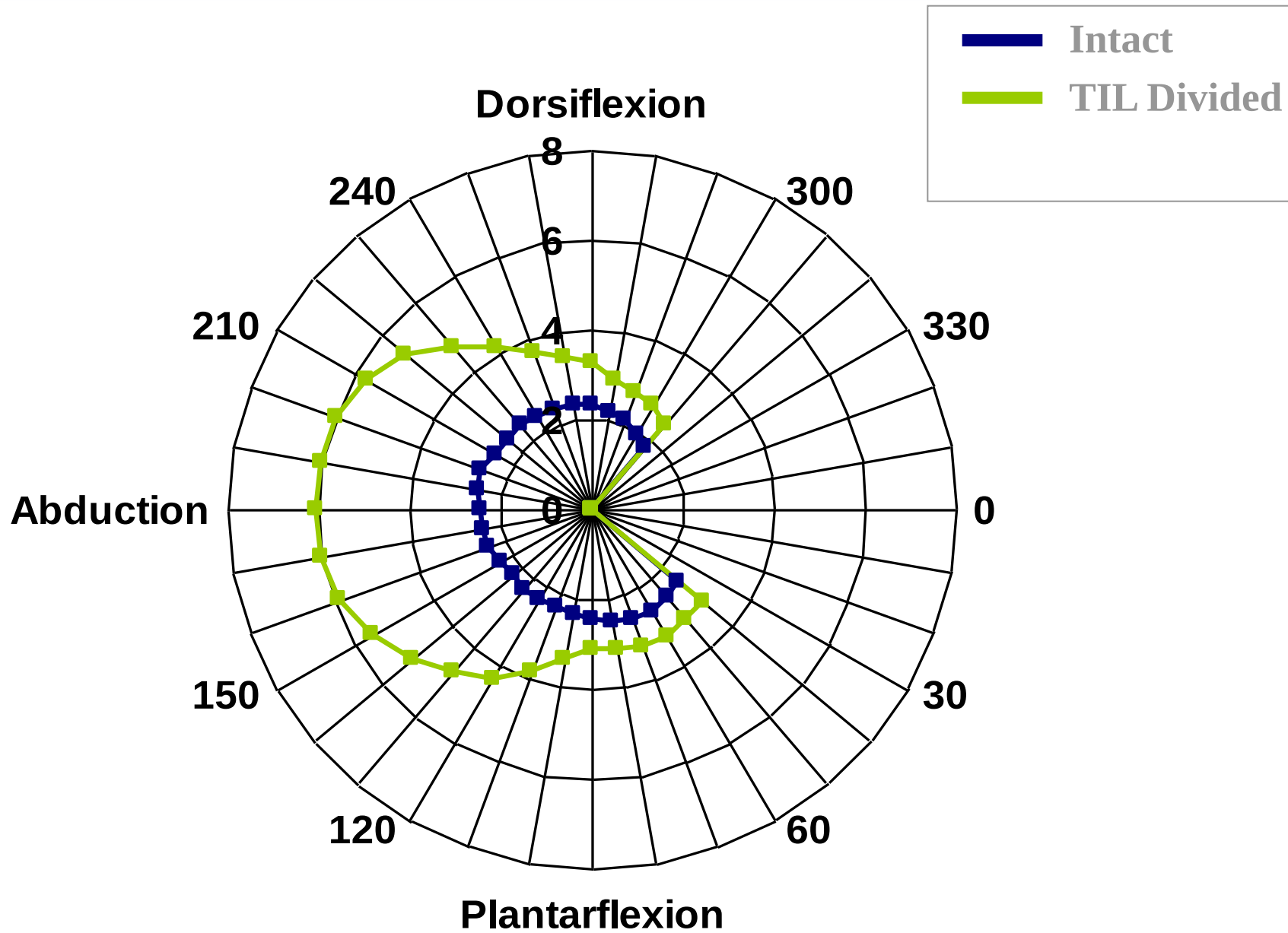


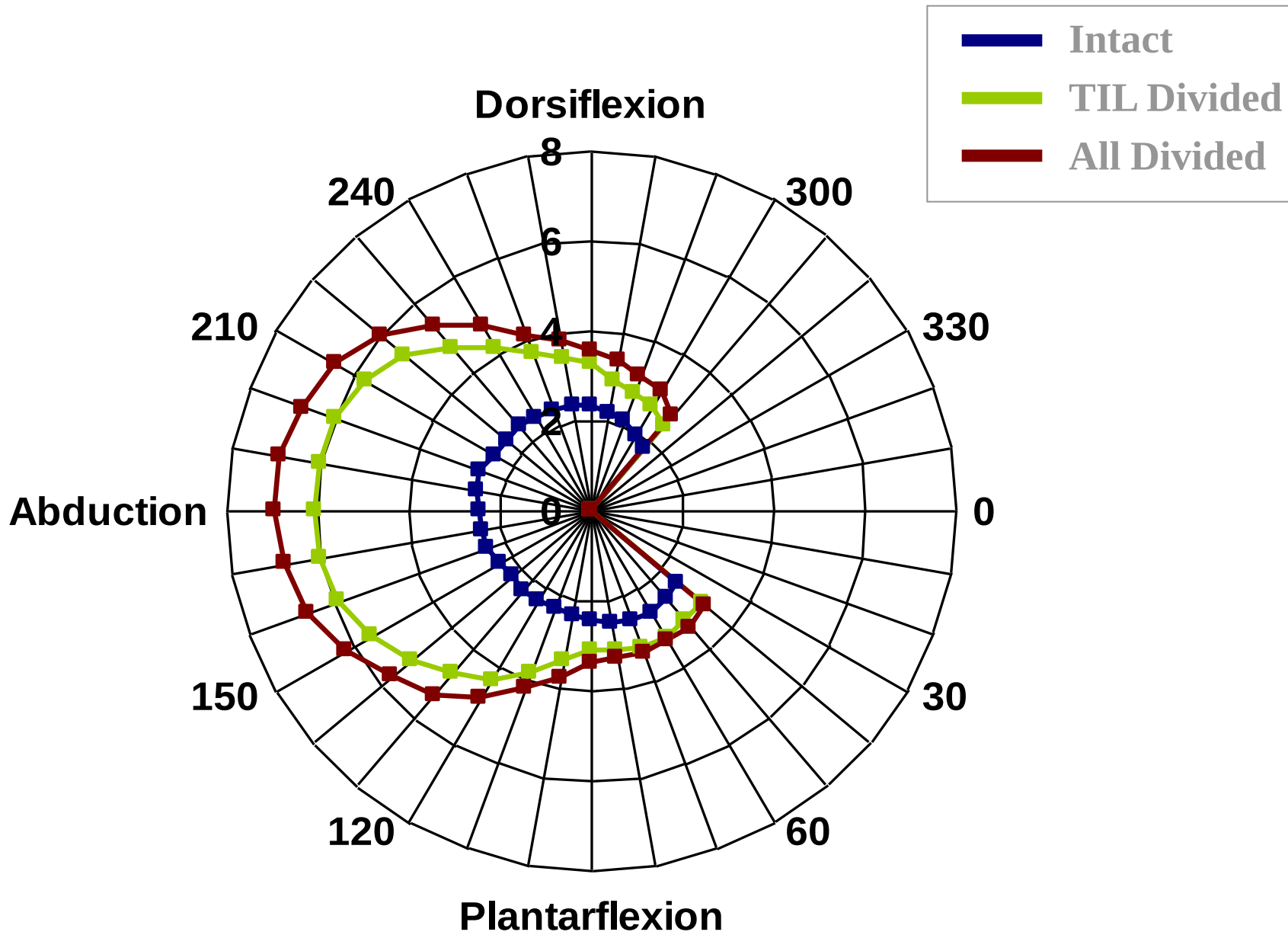




**Abduction**

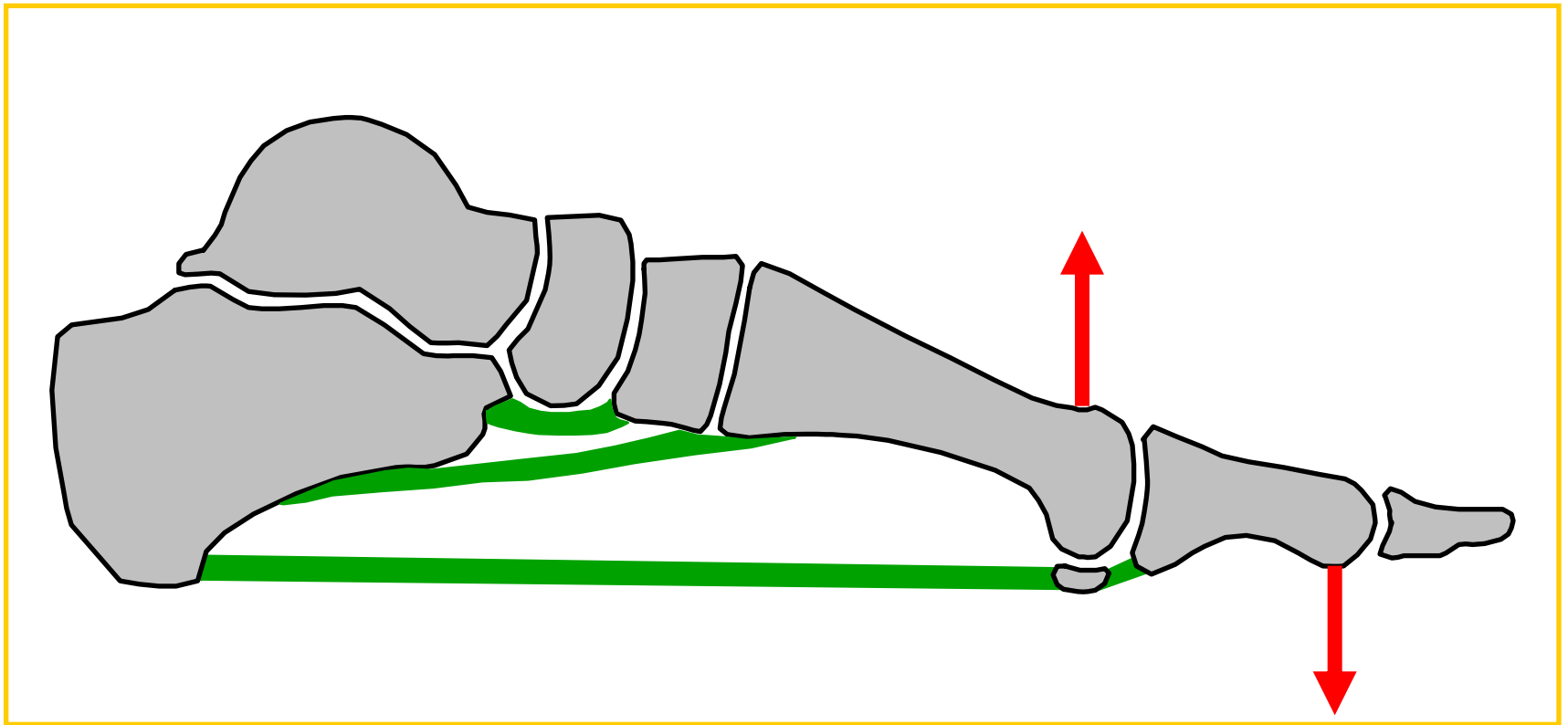




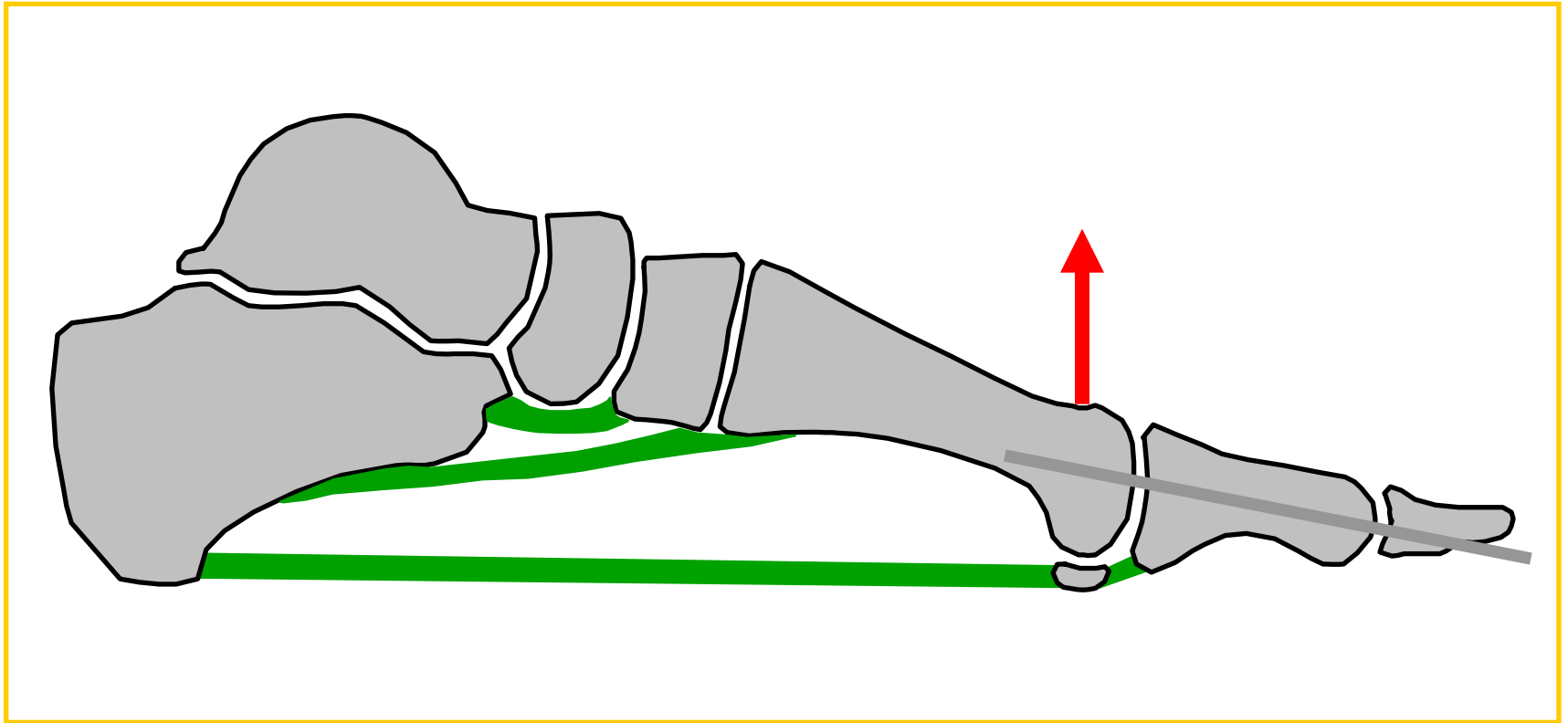




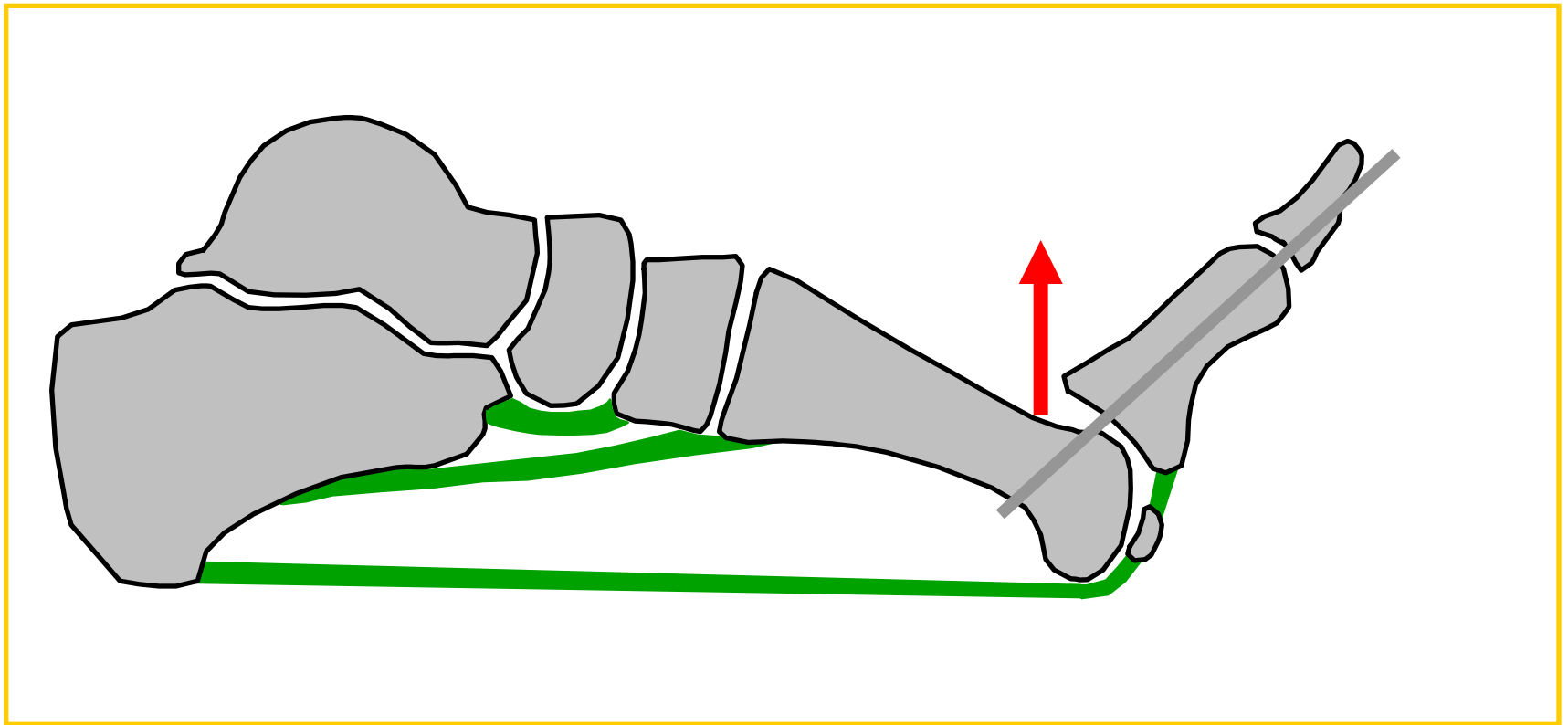
# Hallux Mobile



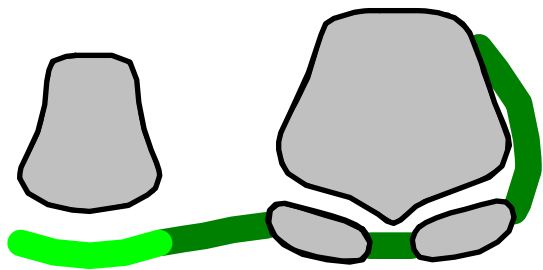
# Hallux Fixed in Neutral



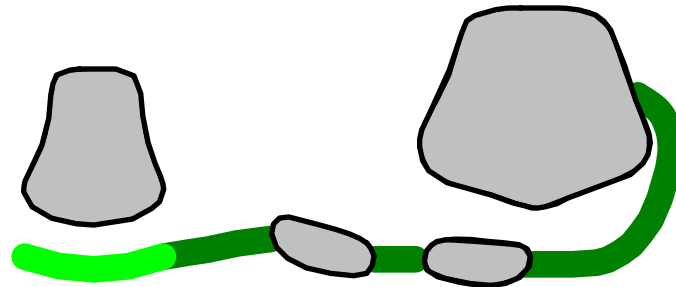
# Hallux Fixed in Extension



# Hallux Valgus

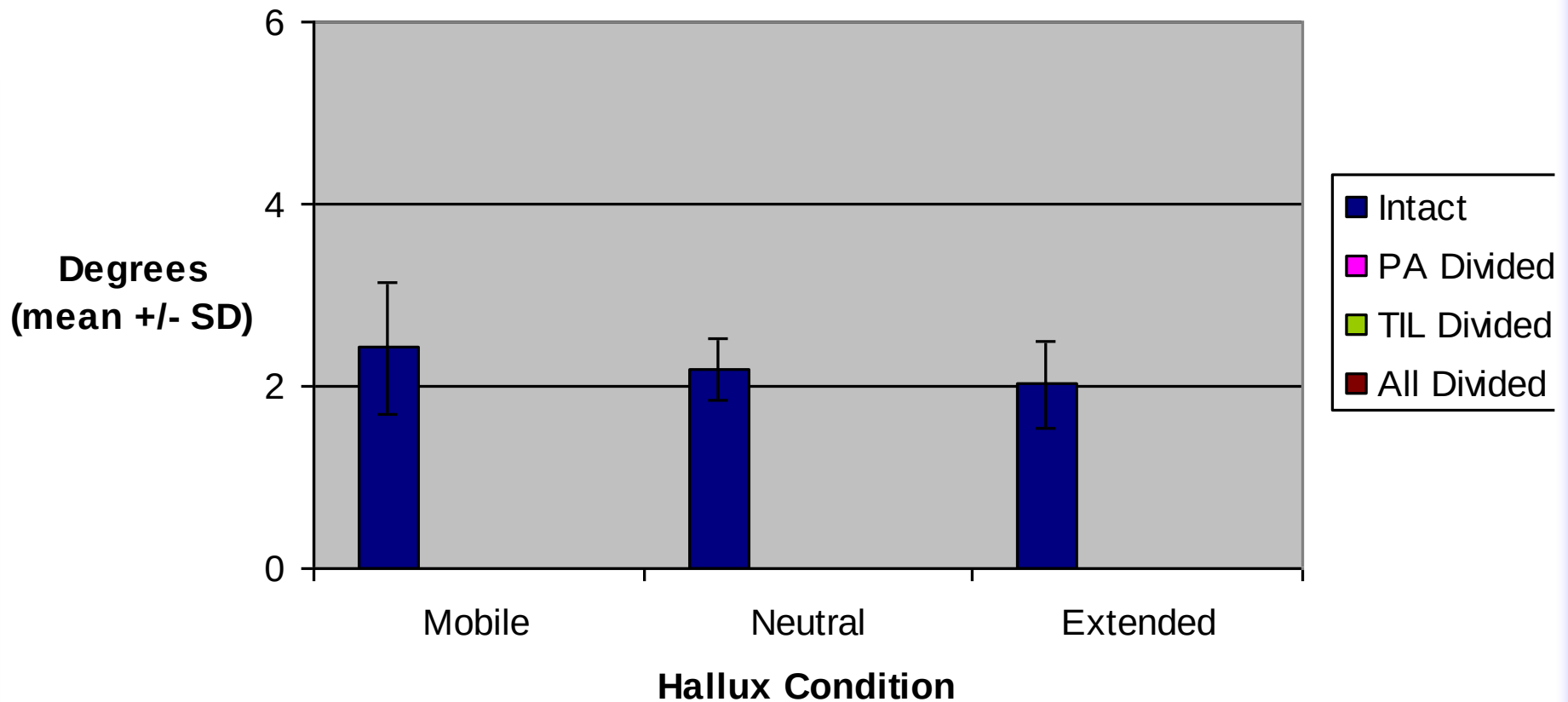


Normal

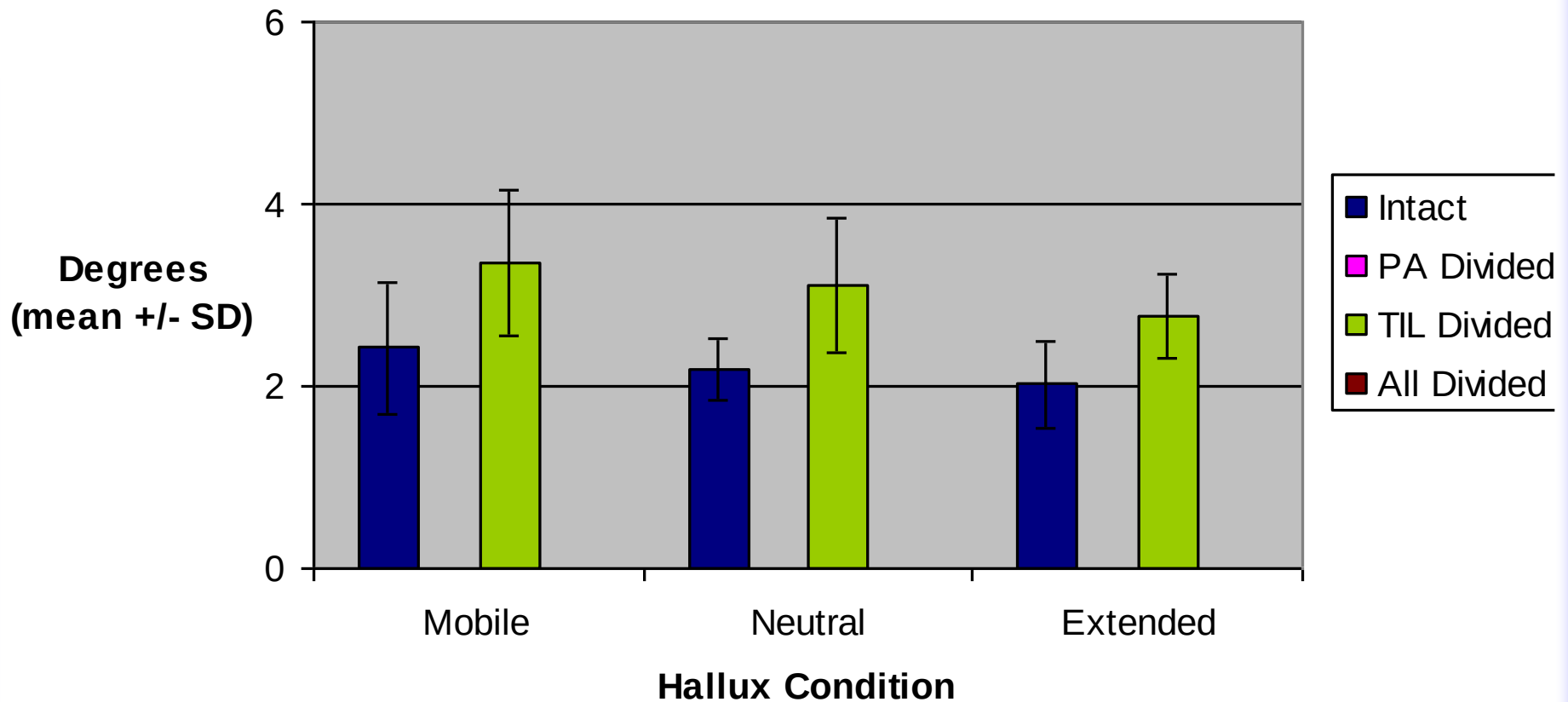


Hallux Valgus

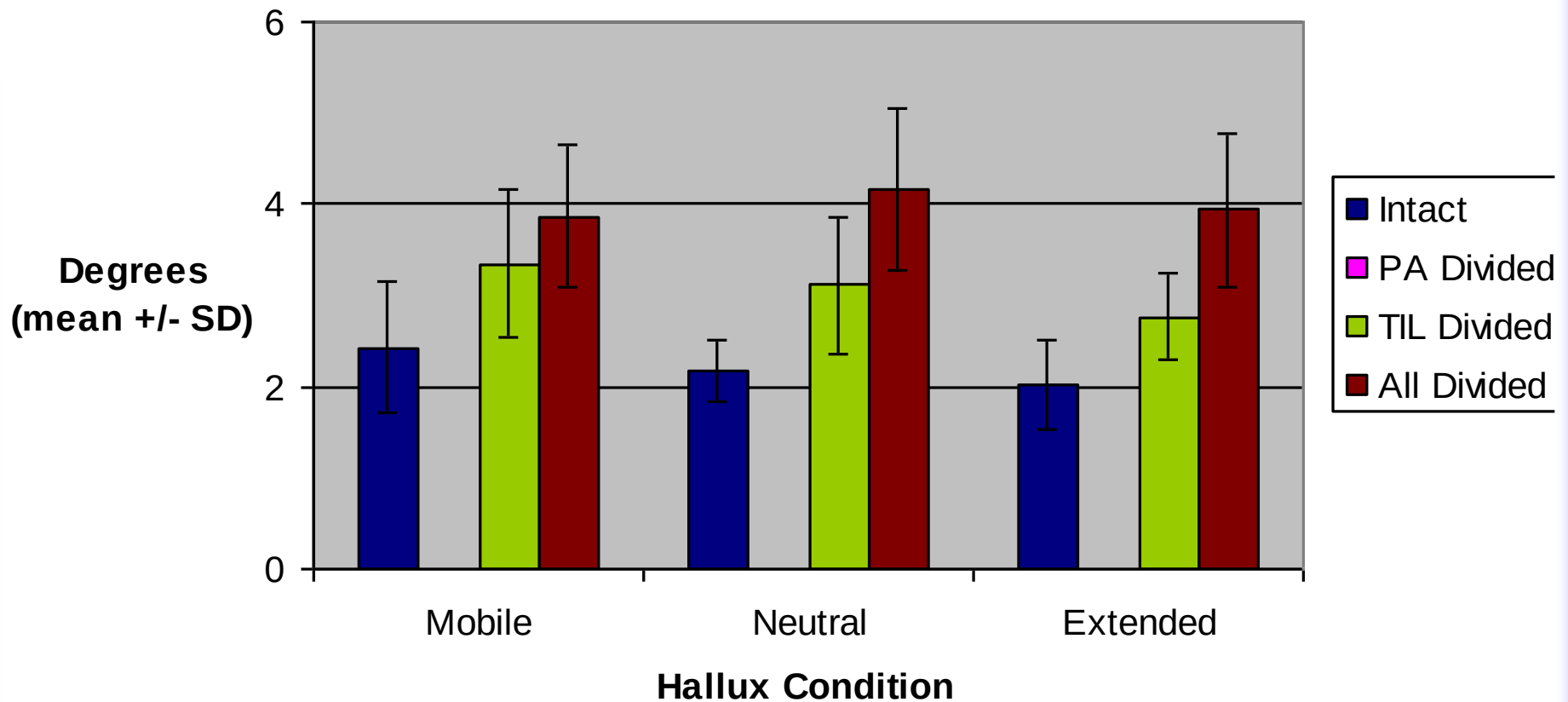
# Metatarsal Dorsiflexion



# Metatarsal Dorsiflexion



# Metatarsal Dorsiflexion



# 1<sup>st</sup> Metatarsal Stability

- DTI is the primary stabiliser
- PA is a secondary stabiliser
- The PA stabilising effect is dependent on restriction of flexion of the hallux
- Extension of the hallux increases the PA stabilising effect



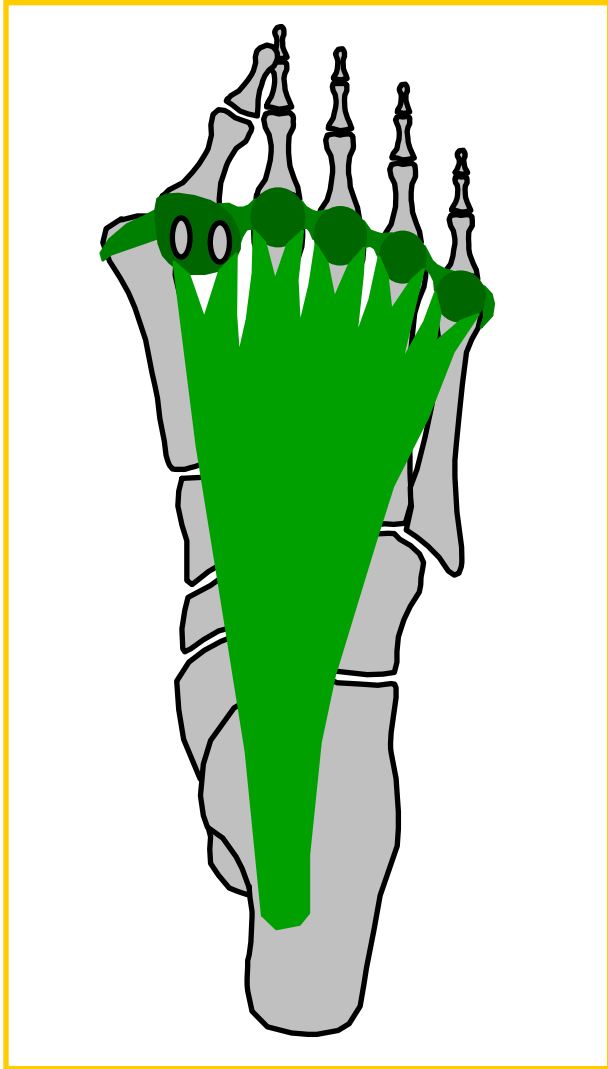
# What Does the Plantar Aponeurosis Do?

- Arch support
- Control of foot shape and limb rotation
- Flexion of the toe MTP joints
- Dynamic stabilisation of 1<sup>st</sup> metatarsal

# Clinical Relevance



# Hallux Valgus



# Claw Toe





# Claw Toe



# Claw Toe v. Hammer Toe



# Claw Toe v. Hammer Toe

|                 | Claw | Hammer |
|-----------------|------|--------|
| MTP extension   | ***  | **     |
| MTP tenderness  | ***  | 0      |
| MTP instability | ***  | 0      |
| PIP flexion     | ***  | ***    |

# Claw Toe v. Hammer Toe

- Hammer toe needs:
  - PIP joint deformity correction
- Claw toe needs:
  - MTP joint reduction and stabilisation
  - PIP joint deformity correction
  - Salvage surgery



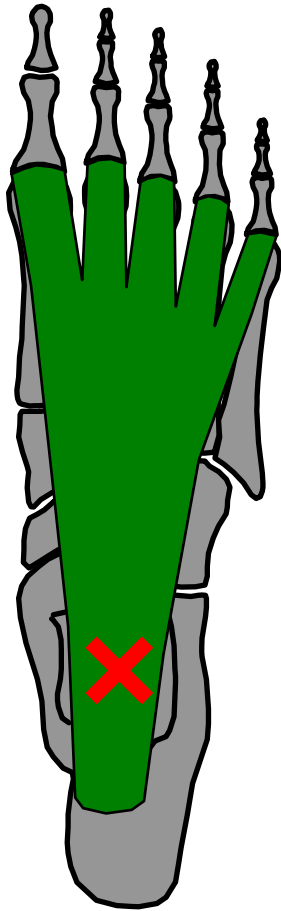
# Flat Foot



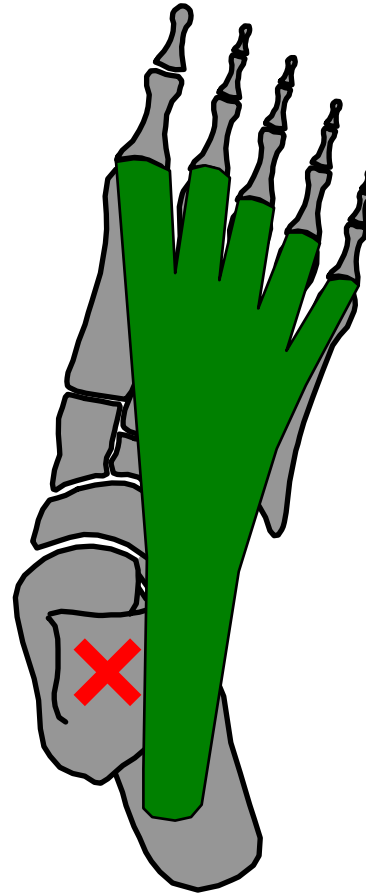
# Flat Foot

- Reduced medial arch
- Forefoot abduction
- Heel pronation
- Impaired toe extension test
- Impaired heel supination on tip-toe

# Flat Foot



Normal



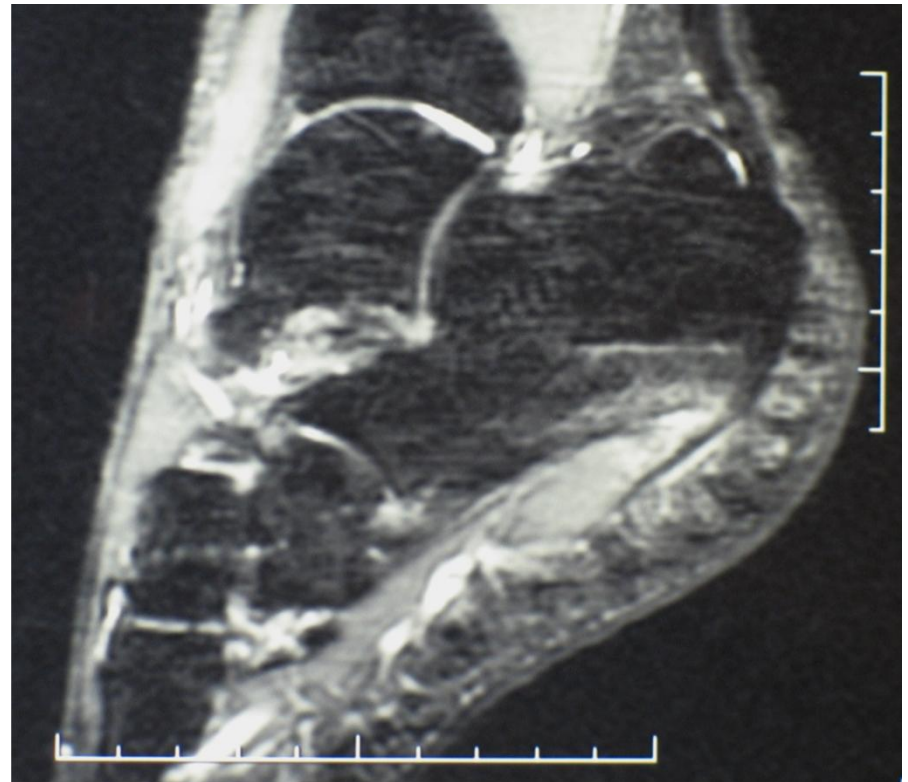
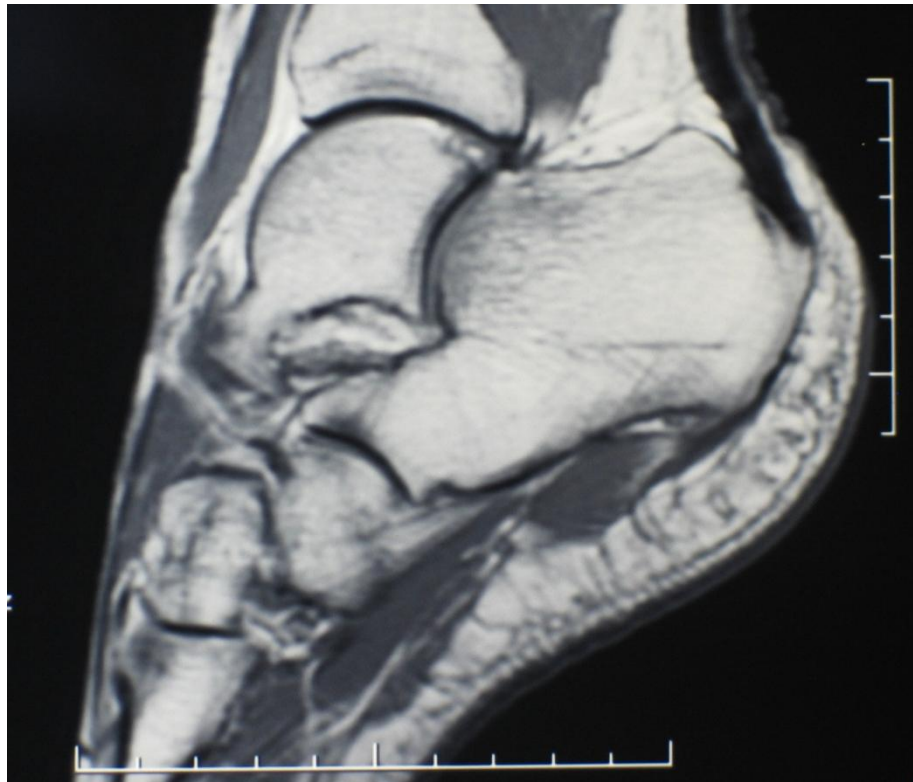
Flatfoot

# Plantar Fasciitis





# Plantar Fasciitis



# Plantar Fasciitis

- Middle aged
- Male preponderance
- Overweight
- Over-use

# Clinical Evaluation of Plantar Aponeurosis Function

- Toe Extension Test



# Clinical Evaluation of Plantar Aponeurosis Function

- Tip-Toe Stance





# Clinical Evaluation of Plantar Aponeurosis Function

- PA Tension Test



# Clinical Evaluation of Plantar Aponeurosis Function

- Toe extension test
- Tip-toe stance
- PA tension test
- MTP joint stability
- Metatarsal stability

# What does the Plantar Aponeurosis do?

- Arch support
- Control of foot shape and limb rotation
- Flexion of the toe MTP joints
- Dynamic stabilisation of 1<sup>st</sup> metatarsal



Thank you

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