Plantar Pressure Analysis & Diagnosis

PRESSURE MAPPING & COMMON CONDITIONS

Step Force Training

Part 3

Presented By
Paul Graham

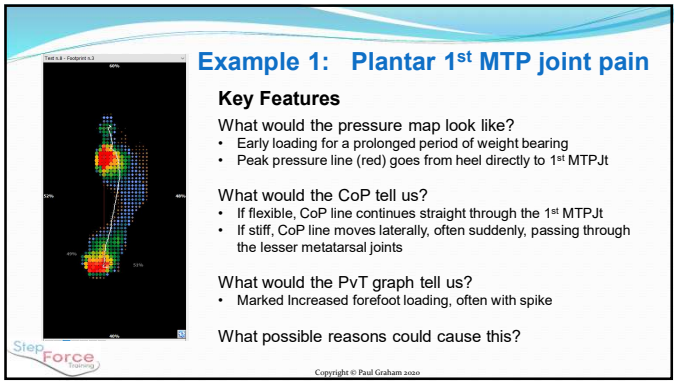
Common Foot Pressure Profiles

Questions to ask for each condition

- What are the features of the pressure map?
- Centre of Pressure - What does it tell us?
- Pressure verses Time graphs - What do they tell us?
- What possible reasons could cause this?
- What tests and investigations should you do?
- How does this inform your possible treatment strategies?

Medial Forefoot pain

1. Plantar 1st MTP joint pain
2. 2nd – 3rd MTP Joints
3. 1st Metatarsocuneiform joint pain


Example 1: Plantar 1st MTP joint pain
Key Features
What would the pressure map look like?
• Early loading for a prolonged period of weight bearing
• Peak pressure line (red) goes from heel directly to 1st MTPJt
What would the CoP tell us?
• If flexible, CoP line continues straight through the 1st MTPJt
• If stiff, CoP line moves laterally, often suddenly, passing through the lesser metatarsal joints
What would the PvT graph tell us?
• Marked Increased forefoot loading, often with spike
What possible reasons could cause this?
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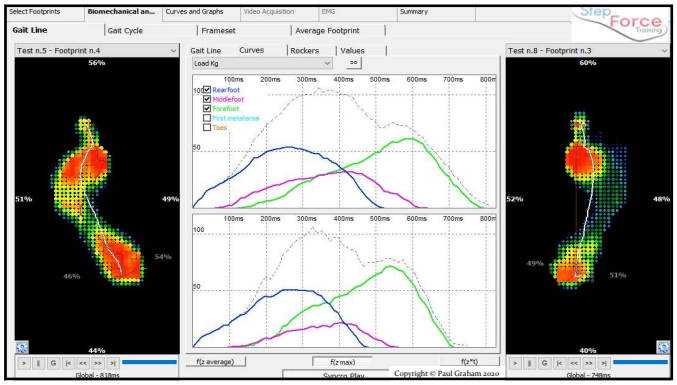
Test n.5 - Footprint n.4
Test n.8 - Footprint n.3
Rearfoot
Midefoot
Forefoot
First metatarsal
Toes
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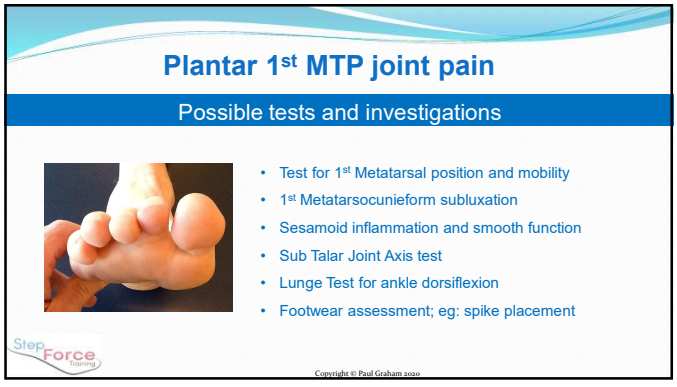
Plantar 1st MTP joint pain
Possible tests and investigations
• Test for 1st Metatarsal position and mobility
• 1st Metatarsocunieform subluxation
• Sesamoid inflammation and smooth function
• Sub Talar Joint Axis test
• Lunge Test for ankle dorsiflexion
• Footwear assessment; eg: spike placement
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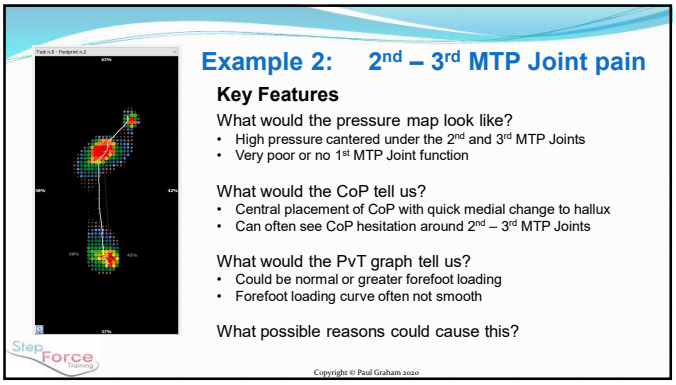
Example 2: 2nd – 3rd MTP Joint pain
Key Features
What would the pressure map look like?
• High pressure cantered under the 2nd and 3rd MTP Joints
• Very poor or no 1st MTP Joint function
What would the CoP tell us?
• Central placement of CoP with quick medial change to hallux
• Can often see CoP hesitation around 2nd – 3rd MTP Joints
What would the PvT graph tell us?
• Could be normal or greater forefoot loading
• Forefoot loading curve often not smooth
What possible reasons could cause this?
Step Force Training
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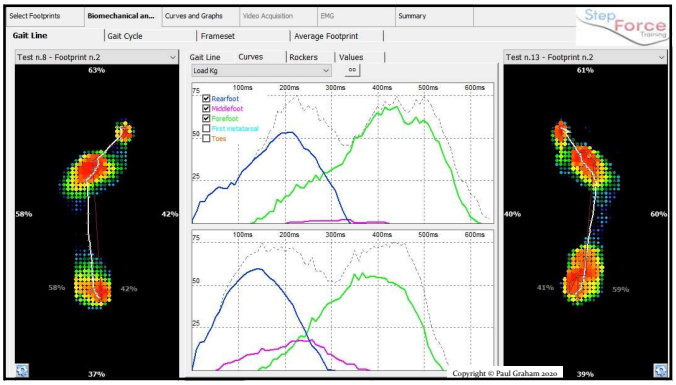
Select Footprints
Biomechanical an...
Curves and Graphs
Video Acquisition
EMG
Summary
Gait Line
Gait Cycle
Frameset
Average Footprint
Test n.8 - Footprint n.2
Test n.13 - Footprint n.2
Rearfoot
Middlefoot
Forefoot
First metatarsal
Toes
Step Force Training
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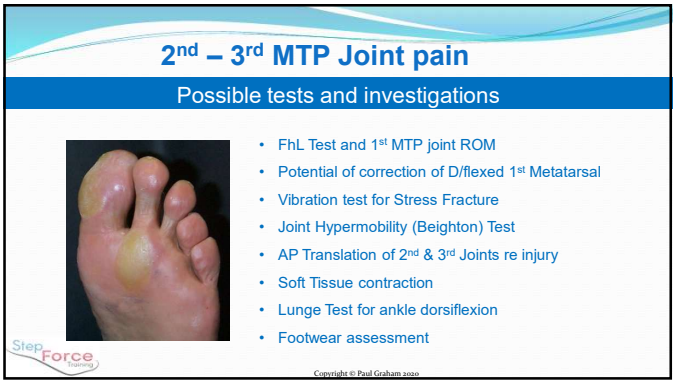
2nd – 3rd MTP Joint pain
Possible tests and investigations
• FhL Test and 1st MTP joint ROM
• Potential of correction of D/flexed 1st Metatarsal
• Vibration test for Stress Fracture
• Joint Hypermobility (Beighton) Test
• AP Translation of 2nd & 3rd Joints re injury
• Soft Tissue contraction
• Lunge Test for ankle dorsiflexion
• Footwear assessment
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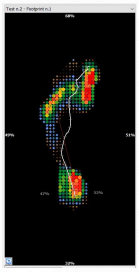
Example 3: 1st Metatarsocunieform joint pain



Key Features

What would the pressure map look like?

- FhL is often seen due to the 1st Metatarocunieform joints involvement

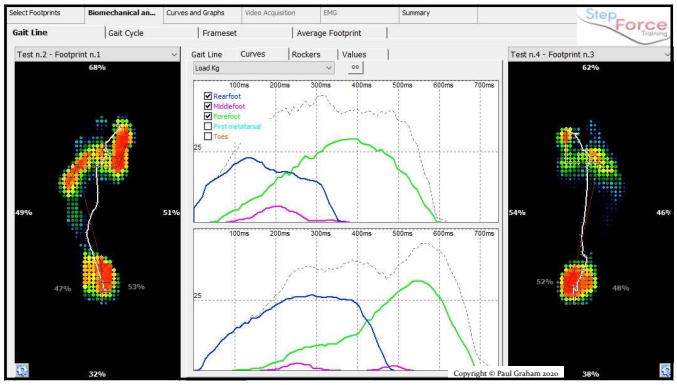
What would the CoP tell us?

- Common to see sharp changes of direction of the CoP, (a number shown in this example) from avoidance of joint blockage or pain
- Hesitation in CoP often seen in midfoot and forefoot

What would the PvT graph tell us?

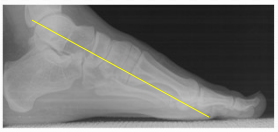
- Prolonged rearfoot curve, small midfoot curve and forefoot, unless there is FhL present

What possible reasons could cause this?



1st MTP and 1st Metatarsocunieform joint pain

Possible tests and investigations

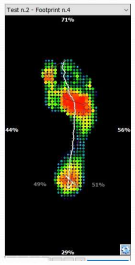


- Functional hallux Limitus (FhL) Test
- Joint Hypermobility (Beighton) Test
- Medial Column joint axes, ROM & subluxations
- 1st ray and Forefoot Soft Tissue contraction
- Tibial Anterior & Posterior strength and function
- Cuboid Alignment Test (CAT)
- Sub Talar Joint Axis test
- Lunge Test for ankle dorsiflexion
- Footwear assessment

Lateral Forefoot pain

1. Neuroma type pain
2. 5th MTP Bunionette
3. Burning forefoot pain

Example 1: Neuroma Type pain



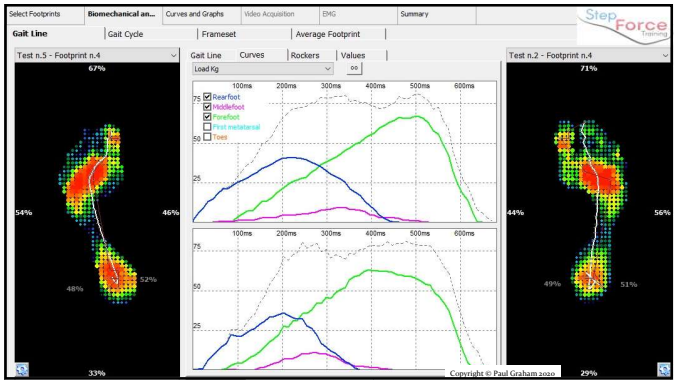
Key Features

What would the pressure map look like?
- High pressure cantered under the 3rd and 4th MTP Joints
- Very poor or no 1st MTP Joint function

What would the CoP tell us?
- Central placement of CoP with quick medial change to hallux
- Can often see CoP hesitation around 3rd MTP Joint

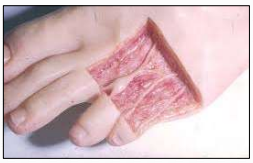
What would the PvT graph tell us?
- Could be normal or greater forefoot loading
- Forefoot loading curve often not smooth

What possible reasons could cause this?

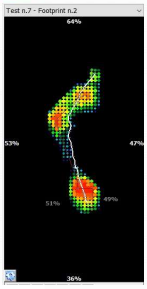


Neuroma Type pain

Possible tests and investigations



- Medial Column function Test
- Soft tissue contractions and adaptation
- Subluxation and restriction of Midfoot joints
- Mulder's and Tinel's sign testing
- Ultrasound diagnostic imaging
- CAT for Cuboid function
- Peroneal Inhibition Tests
- Inferior & Superior Tibiofibular subluxation
- Lunge Test for ankle dorsiflexion



Example 2: 5th MTP 'Bunionette'

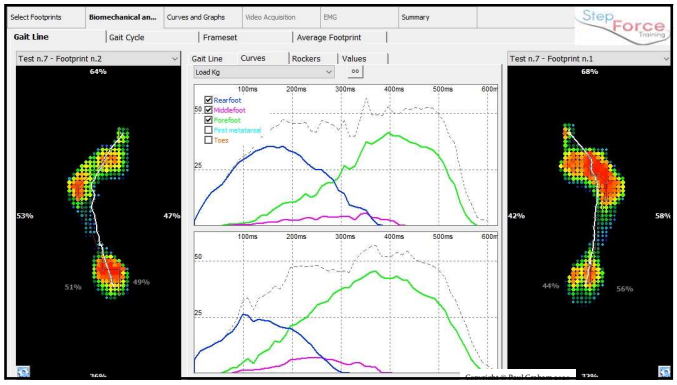
Key Features

What would the pressure map look like?
- High pressure centered under the 5th MTP Joint and metatarsal
- Often due to hereditary structure and joint alignment

What would the CoP tell us?
- Usually a prolonged lateral placement of CoP
- Peak pressure line (Red) goes through the 5th Met and MTPJt

What would the PvT graph tell us?
- Forefoot loading greater and prolonged with hesitations

What possible reasons could cause this?

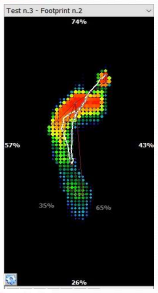


5th MTP 'Bunionette'

Possible tests and investigations

- Medial Column function Test
- Soft tissue contractions and adaptation
- Subluxation and restriction of Midfoot joints
- CAT for Cuboid function
- Peroneal Inhibition Tests
- Inferior & Superior Tibiofibular subluxation
- Lunge Test for ankle dorsiflexion
- Footwear commonly worn

Example 3: Burning forefoot pain



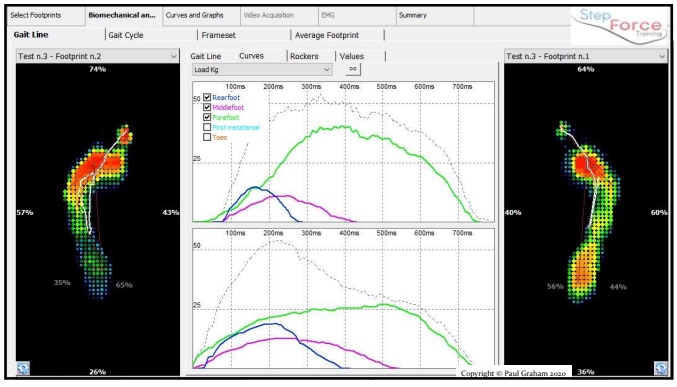
Key Features

What would the pressure map look like?
- Very high and prolonged pressure often across all forefoot
- Very poor weight bearing in heel – rearfoot area

What would the CoP tell us?
- Often CoP will start in midfoot as not enough heel contacts
- Central placement of CoP, often shows reversals / hesitations

What would the PvT graph tell us?
- Very small rearfoot curve for short period only
- Significant and prolonged Forefoot loading curve

What possible reasons could cause this?



Burning forefoot pain

Possible tests and investigations

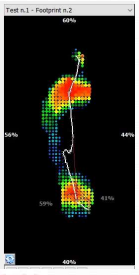
- Joint Hypermobility (Beighton) Test
- Medial Column function Test
- Soft tissue contractions and adaptation
- Subluxation and restriction of Midfoot joints
- Slump test for neural tightness
- Tinel's Test for referred nerve pain in feet
- Inferior & Superior Tibiofibular subluxation
- Lunge Test for ankle dorsiflexion
- Footwear commonly worn

Midfoot and Heel pain

- Cuneiform joint pain
- Dorsolateral midfoot pain (DICS)
- Lateral column / Cuboid joint pain

* Plantar fascial pain will be presented next session, with intervention.

Example 1: Central Cuneiform Joints Pain



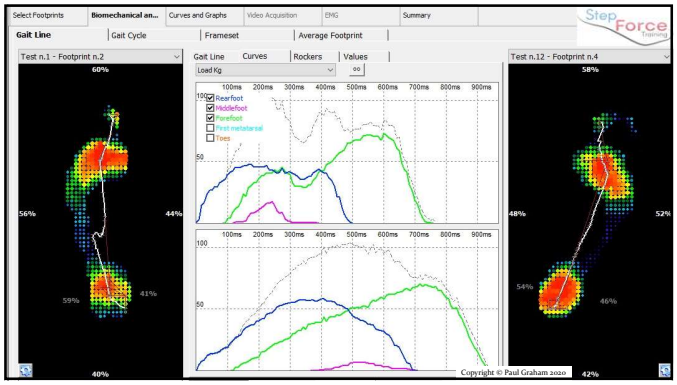
Key Features

What would the pressure map look like?
- High pressure under the 2nd and 3rd MTP Joints
- Can have lateral loading depending on pain / restriction

What would the CoP tell us?
- Key is the CoP hesitation as the midfoot joints begin loading

What would the PvT graph tell us?
- Often graphs are steep to offload rearfoot and load forefoot
- Steep, short midfoot graph,

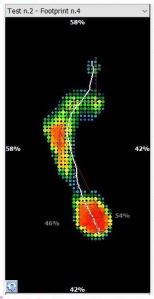
What possible reasons could cause this?



Central Cuneiform Joints Pain

Possible tests and investigations

- FhL Test
- Joint Hypermobility (Beighton) Test
- Subluxion of Medial Column joints
- Talar Congruency Test
- Strength / function of Tib Post & Ant
- CAT for Cuboid function
- Sub Talar Joint Axis Test
- Soft Tissue contraction
- Lunge Test for ankle dorsiflexion



Example 2: Dorsolateral Midfoot pain

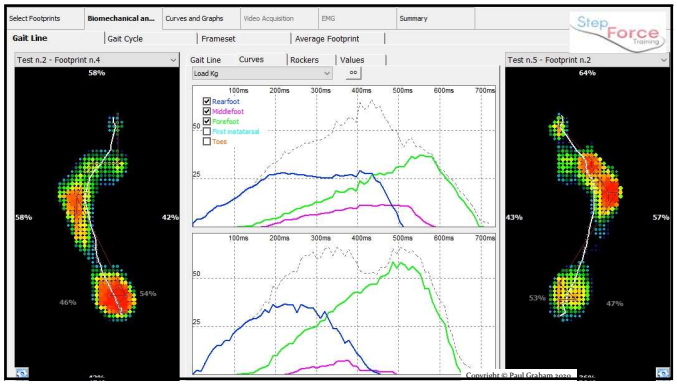
Key Features

What would the pressure map look like?
- Often high pressure in heel and 3rd – 5th MTP Joints
- Very poor or no 1st MTP Joint function

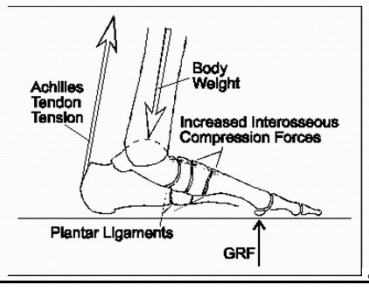
What would the CoP tell us?
- Central placement of CoP, but peak line goes through lateral Column

What would the PvT graph tell us?
- Prolonged Rearfoot and Midfoot loading with quick off loading
- Extended Midfoot loading curve often not smooth

What possible reasons could cause this?



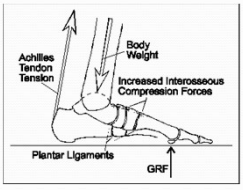
Dorsal interosseous compression syndrome



Dorsolateral Midfoot pain

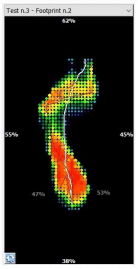
(Dorsal interosseous compression syndrome)

Possible tests and investigations



- FHL and Joint Hypermobility (Beighton) Test
- Subluxation of Medial Column joints
- Talar Congruency and Joint Axis Test
- Strength / function of intrinsic, Tib Post & Ant muscles
- CAT for Cuboid function
- Check foot rocker timing and symmetry
- Soft Tissue contraction
- Lunge Test for ankle dorsiflexion

Example 3: Lateral Column / Cuboid Joint pain



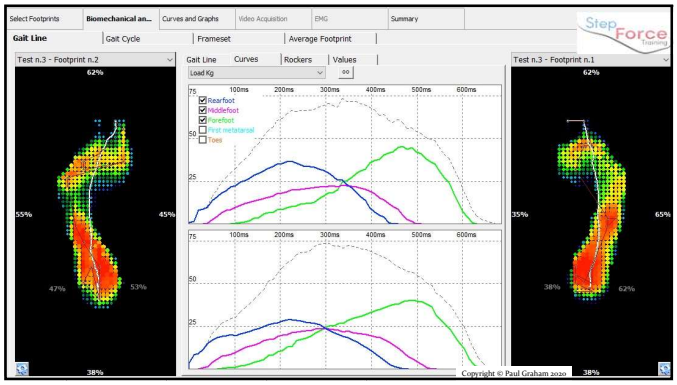
Key Features

What would the pressure map look like?
- High pressure centered under lateral Column, especially the Cuboid
- Lateral structures show high loading into late midstance

What would the CoP tell us?
- lateral placement of CoP with hesitation in rearfoot and midfoot Joints

What would the PvT graph tell us?
- Often greater or prolonged rearfoot and midfoot loading
- Loading curves are often not symmetrical or smooth

What possible reasons could cause this?



Lateral Column / Cuboid Joint pain

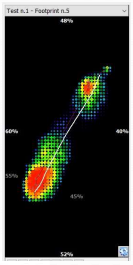
Possible tests and investigations

- Medial Column function Test
- Soft tissue contractions and adaptation
- Subluxation and restriction of Midfoot joints
- CAT for Cuboid function
- Peroneal Inhibition Tests
- Inferior & Superior Tibiofibular subluxation
- Lunge Test for ankle dorsiflexion
- Sub Talar Joint Axis Test

Medial and Lateral ankle pain

- PTTD / Adult flatfoot
- Medial Ankle pain
- Lateral Ankle / Peroneal tendons pain
- Achilles pain

Example 1: PTTD / Adult Flatfoot Pain



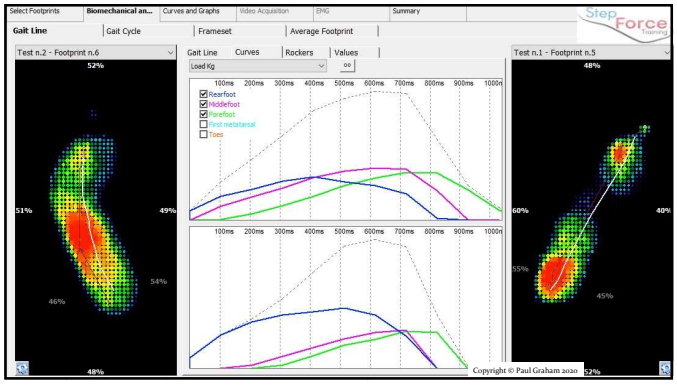
Key Features

What would the pressure map look like?
- High pressure through the medial aspect of the foot
- Often weight bearing through the arch
- Sometimes high pressure just from rearfoot to 1st MTP Joint

What would the CoP tell us?
- Often a straight medial placement of CoP

What would the PvT graph tell us?
- Greater rearfoot and often prolonged Rearfoot and midfoot loading

What possible reasons could cause this?

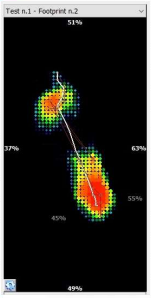


PTTD / Adult Flatfoot Pain

Possible tests and investigations

- Joint Hypermobility (Beighton) Test
- Subluxation of Medial Column joints
- Single leg on toes standing test
- Talar Congruency Test
- Strength / function of Tibialis Posterior in particular
- Classification of what stage condition is
- Sub Talar Joint Axis Test
- Soft Tissue contraction
- Lunge Test for ankle dorsiflexion

Example 2: Medial Ankle Pain



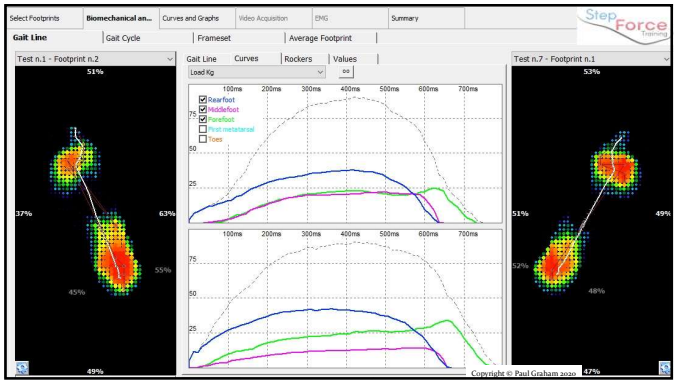
Key Features

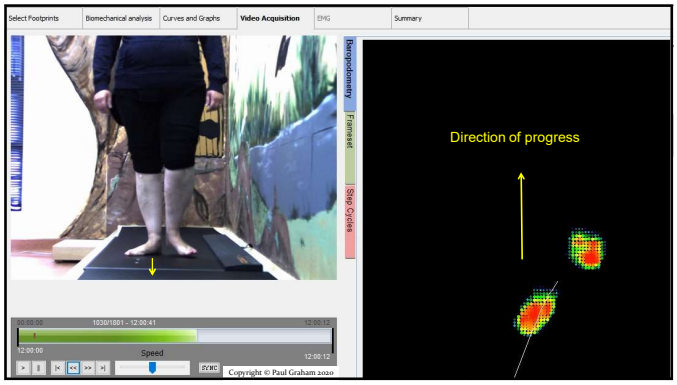
What would the pressure map look like?
- High pressure through the medial aspect of the Rearfoot
- Often weight bearing through the Distal arch

What would the CoP tell us?
- Often a straight Central placement of CoP

What would the PvT graph tell us?
- Greater and prolonged Rearfoot and midfoot loading
- Some evidence of (poor) windlass function

What possible reasons could cause this?



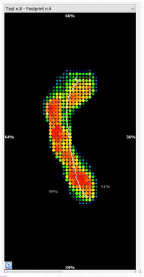


Medial Ankle Pain

Possible tests and investigations

- Joint Hypermobility (Beighton) Test
- Subluxation of Medial Column joints
- Single leg on toes standing test
- Talar Congruency Test
- Strength / function of Tibialis Anterior and Posterior
- Sub Talar Joint Axis Test
- Soft Tissue contraction
- Lunge Test for ankle dorsiflexion

Example 3: Lateral Ankle / Peroneal Pain



Key Features

What would the pressure map look like?

- High pressure centered under the lateral Column for the stance phase
- Often high loading under styloid process

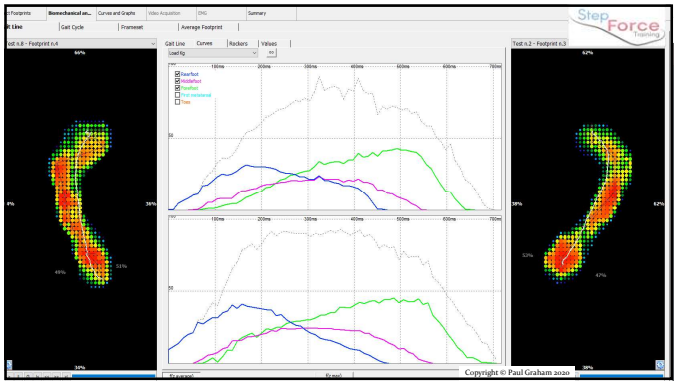
What would the CoP tell us?

- Lateral placement of CoP with hesitations often just prior to loading response and midstance phases of stance

What would the PvT graph tell us?

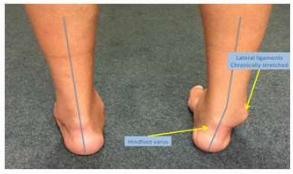
- Could be normal or greater midfoot loading
- Loading curves not symmetrical or smooth depending on hesitations

What possible reasons could cause this?



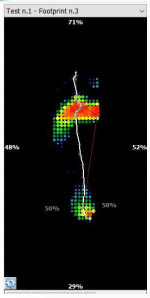
Lateral Ankle / Peroneal Pain

Possible tests and investigations



- Medial Column function Test
- Soft tissue contractions and adaptation
- Subluxation and restriction of Midfoot joints
- CAT for Cuboid function
- Peroneal Inhibition Tests
- Inferior & Superior Tibiofibular subluxation
- Lunge Test for ankle dorsiflexion
- Sub Talar Joint Axis Test

Example 4: Achilles Pain



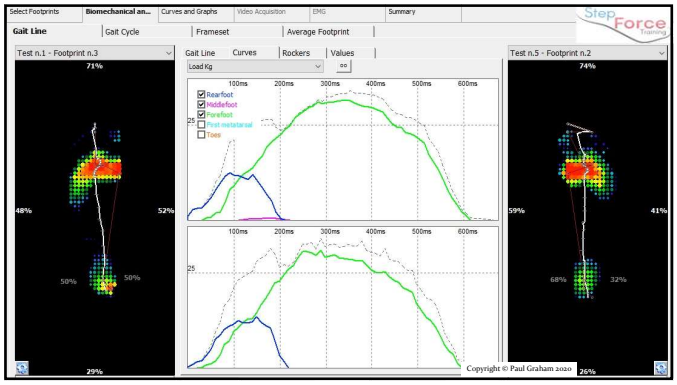
Key Features

What would the pressure map look like?
- High pressure under the forefoot, often little loading in heel
- Can be large variance between tests, due to offloading habits

What would the CoP tell us?
- Central placement of CoP rarely with hesitations

What would the PvT graph tell us?
- Very small and short rearfoot curve with prolonged and enlarged forefoot curve, often not smooth in transition

What possible reasons could cause this?



Achilles Pain

Possible tests and investigations

- Core muscle strength and function
- Posterior muscle chain function and stiffness
- Joint Hypermobility (Beighton) Test
- Subluxation of Medial Column joints
- Sub Talar Joint Axis Test
- Local Soft Tissue contraction inflammatory state
- Lunge Test for ankle dorsiflexion

Q & A Discussion