


CADCAM Orthotic Prescription and Design


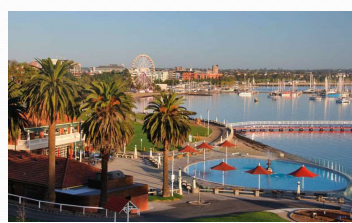

Session 1

Essentials of Orthomechanical Therapy




Presented By
Paul Graham

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Current Member of the Australian Pain Society

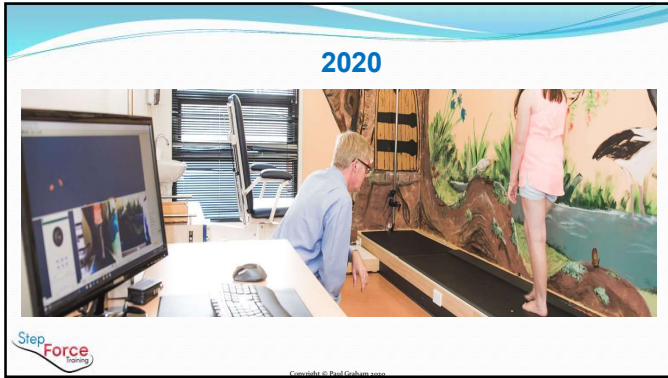


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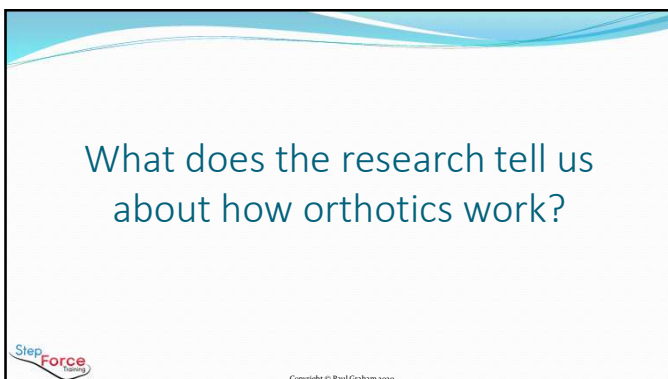
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Does this really happen?

Natural Relief



Before | After

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Different Types of Research Study

1. Cross-sectional
2. Prospective
3. Meta-Analysis
4. Outcome

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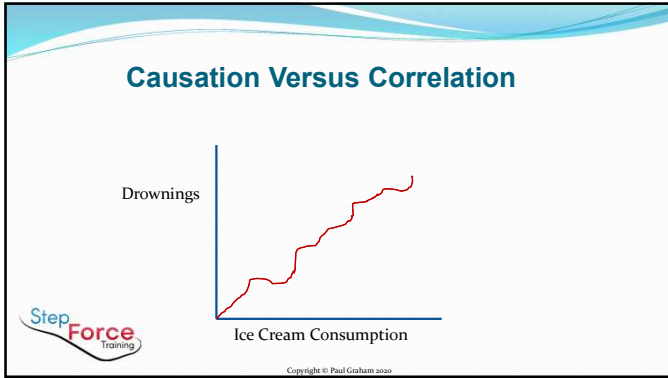
Cross Sectional Studies

1. Bunions and 'flat feet'
Kalen & Brochner 1988, Inman 1976, Goldner & Gaines 1976
2. MTSS (Shin Splints) and pronated feet
Vittasool & Kviat 1983, Messier & Pittala 1988
3. No Correlation
Rome et al 2001, Hogan et al 2002
4. Pronated foot protective role
Cain et al 2006

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Prospective Studies

1. No relationship between foot pronation and overuse injuries
 Cowan et al. 1992., Brusseull et al. 1998, Hetrsroni et al 2006
 Wen et al. 1998, Kaufman Brodine & Shaffer 1999, Burns et al. 2005
 Michelson Durant McFarland 2002, Giladi et al. 1985
2. Weak relationship between foot pronation and overuse injuries
 White & Yates 2002, Reinking 2006 Williams et al.L 2007

BUT.....

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Meta-Analysis Studies

1. Association Between Foot Type and Lower Extremity Injuries: Systematic Literature Review With Meta-analysis: josp.2013
2. Foot posture as a risk factor for lower limb overuse injury: a systematic review and meta-analysis Neal et al 2014


Conclusion:
'Excess Pronation' is a very small risk factor, although statistically significant.

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**But Outcome studies show
Orthotics do work!**

*Is there another way orthotics work
than by limiting excessive frontal
plane movement?*




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But how do they work?

Effect of inverted orthoses on lower-extremity
mechanics in runners 2003.
Williams DS 3rd¹, McClay Davis I, Baitch SP.

Their Study found:
*The reduction in force loading was the only statistically
significant change provided by orthotics*



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But how do they work?

Influence of a custom foot orthotic intervention on
lower extremity dynamics in healthy runners, 2006
MacLean C, McClay Davis I, Hamill J.

Their Study found:
Orthotics changed max rearfoot eversion by 1 degree in 10/15

But

Orthotics reduced the ankle inversion moment up to 70% in 14/15




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But how do they work?


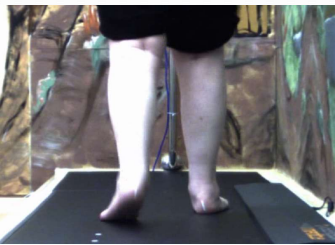
*We have to think about **force** and the **loading** and the **adaptations** of the tissues - **not just posture and alignment***



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Gait Analysis
VISUAL Only



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Gait Analysis
VISUAL Plus Pressure Data



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Force & Biomechanics Foundations

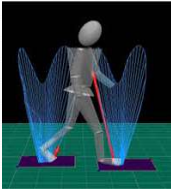



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The Force we live with daily



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Gravity

Ground Reaction Force

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How is force transmitted?



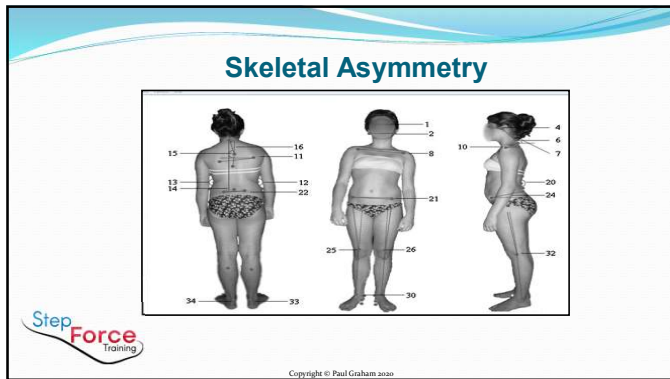
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Forces mediated through skeleton

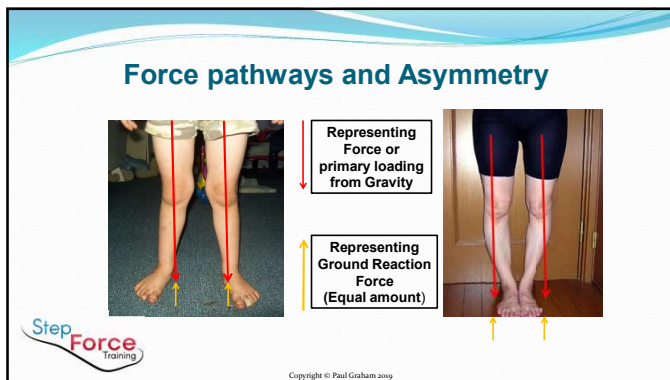
Supported by connective tissues

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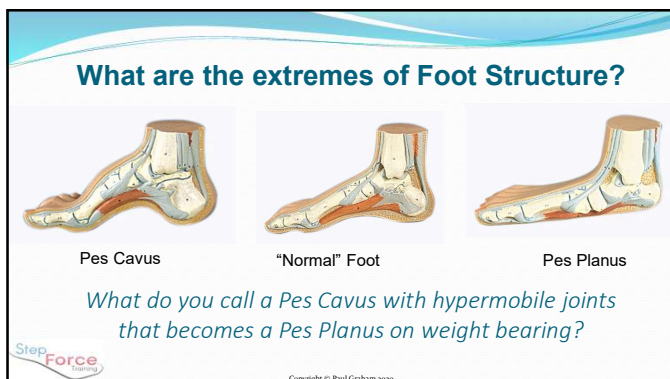
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How has the patient's life experience affected their function?


- Current Episode of Pain
- Pregnancy
- Age
- Work Habits
- Over Training
- Being overweight
- Footwear
- Medical conditions
- Previous injury
- Surgical Outcomes


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Body's ability to compensate this to prevent overload

1. Neural Coordination and receptor feedback




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Body's ability to compensate this to prevent overload

2. Muscle strength



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Body's ability to compensate this to prevent overload

3. Soft Tissue elasticity and flexibility



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Body's ability to compensate this to prevent overload

4. Joint range of motion




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The MAIN Compensatory movement of the foot is PRONATION!



What then, are we seeing in a weight bearing view?

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Why do people get injured?

- Structural misplacement of force
- ↓
- Overloading of joints / soft tissues
- ↓
- Gait and postural adaptation
- ↓
- Further loading and dysfunction
- ↓
- Tissue failure and inflammation



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Forces, Function and Joint Stiffness



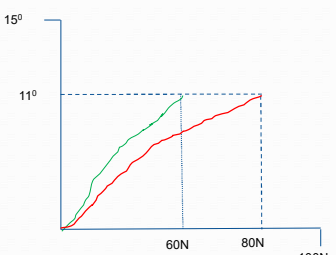
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Joint ROM Vs Joint Stiffness

Concept of joint stiffness Vs ROM



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Forces, function and Orthomechanics

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Forces, function and Orthomechanics

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Forces, Function and Joint Stiffness

High stiffness spring

GRF

GRF

GRF

Foot C: High Forefoot Dorsiflexion Stiffness

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Foces, Function and Joint Stiffness

Foot A: Low Forefoot Dorsiflexion Stiffness

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Foces, Function and Joint Stiffness

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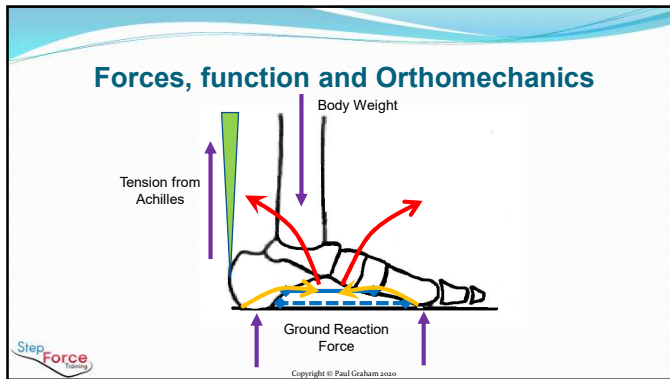
Foces, Function and Joint Stiffness

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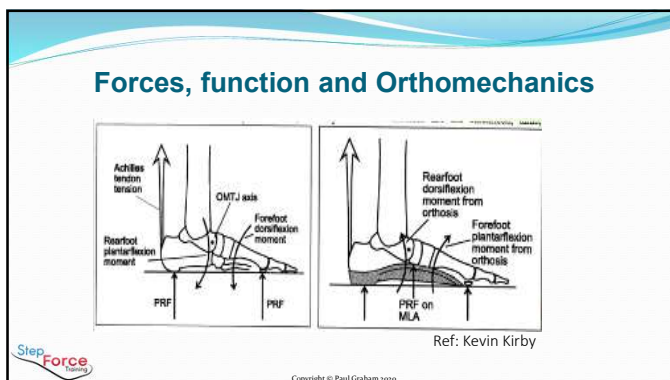
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So, are orthotics permanent?

It depends on the reason for the prescription...

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So, are orthotics permanent?

Influencing Factors:

- **Skeletal Misalignments and Asymmetry**
 - Influencing force pathway
- **Neural Feedback and pathways**
- **Potential to increase the body's ability to compensate**
 - Joint mobility and stiffness effect
 - Muscle Strength
 - Soft Tissue Elasticity

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So, are orthotics permanent?

Standard Deviation	Percentage
3σ	0.1%
2σ	2.1%
1σ	13.6%
μ (Mean)	34.1%
1σ	13.6%
2σ	2.1%
3σ	0.1%

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So, are orthotics permanent?

Who needs orthotics for the Longer term?

- Major structural misalignment
- Anatomical anomalies
- Genetic predispositions
- High risk feet
- Neuromuscular
- Neurological
- Injury or deformity


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So, are orthotics permanent?

- **Kinematic / Posture view (To correct flat feet)**
 - Based on a neutral Subtalar Joint at Midstance model
 - Everything is in the orthotic design
 - Required for life
- **Kinetic / Tissue Stress theory view**
 - Based on 'normalising' the forces applied to the foot
 - Includes other therapies to improve function
 - Not everyone requires orthotics to be worn at all times




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So, are orthotics permanent?

Who are the people who may not need to wear orthotics continually for the shorter term?

- Teenagers
- Sports people finding increased intensity causing symptoms
- As part of a rehabilitation process
- People with adaptations who are motivated to resolve them
- People who loose a large amount of weight



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Orthotic design

Consider, what is:

- The patient's main concern?
- Your diagnosis and treatment strategy?
- The aim of the orthotics?
- The material that the respiration test indicates is needed?
- The correction orthotic type required for each foot?
- The footwear in which they will be wearing the orthotics?
- The extra prescription options required?



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Orthotic Function in Gait

Initial Contact Loading Response Mid Stance Terminal Stance Pre-Swing

GRF GRF GRF GRF GRF

Orthotic length Vs Correction potential

Soft materials Vs Hard thermoplastics

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How orthotics based on different design criteria provide relief for various conditions

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Arch Supports / Orthotics

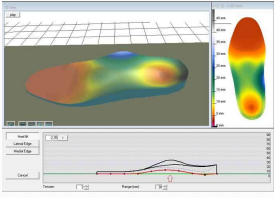
- Can be Premade or Custom
- Redistribute Force
- Improve Proprioception
- Limit joints' functioning at end ROM
- Assist rehabilitation of muscle imbalance

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Total Contact Orthotics

- Diabetes
- Significant Osteoarthritis conditions
- Localise Neural hypersensitivity
- Difficult and Inflammatory conditions



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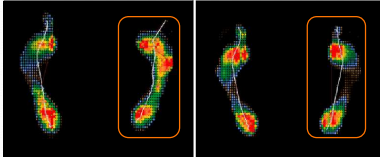
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Orthotics that correct CoP

Main Correction Designs

- Midfoot
- Kirby Skive addition to midfoot design
- Blake Inverted or Rearfoot correction design



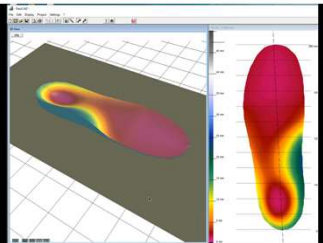
We could possibly call them 'rehabilitation orthotics'

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Midfoot Orthotic Design

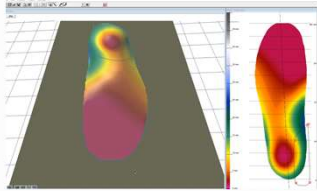


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Midfoot plus Kirby Skive design with Forefoot Valgus control feature

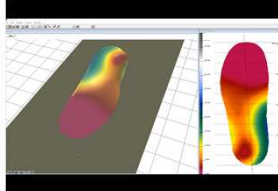


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Rearfoot or Blake design



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Q & A Discussion



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