The Foot Core

A New Way to Approach Foot Pathology

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The Foot Core Concept
International Foot and Ankle Symposium, 2012

Lumbo-Pelvic Core Stability

Heel Pain—Plantar Fasciitis:
Clinical Practice Guidelines
Linked to the International Classification
of Functioning, Disability, and Health
from the Orthopaedic Section of the
American Physical Therapy Association

Recommend: Modalities, Manual Therapy, Stretching,
Taping, Orthotic Devices, Night Splints
No recommendations regarding strengthening
Every other Practice Guideline (knee, ankle, etc.)
recommend strengthening
Need for awareness of the importance of foot strength for
normal foot function

Proposing that there is an analogy in the foot
Intrinsic Foot Muscles
Small X-sectional areas
Short moment arms
Stabilizers vs prime movers

You need foot stability (intrinsic) for proper foot
mobility (prime movers) and proper function
Importance of foot strength highly underappreciated

Explore the Concept of a Foot Core
Formation of the Arch

Bipedalism for Several million yrs
Greater demands of running
Med. Long. Arch
Long achilles

Plantar intrinsic activity most consistent during running, least during walking

Bramble and Lieberman, 2004

Well- Designed Feet

26 bones, 33 joints with 6 dof of movement
4 layers of arch muscles

Rigid Lever, Mobile Adapter, Spring

There is a high prevalence of flat feet

Normal feet often degrade under load

Pronation can happen in the rear and/or midfoot
One can have normal RF motion…

But have excessive midfoot motion

**Plantar Fasciitis**

Most common cause of heel pain
10% of population will experience ~32 million people!

**Mechanism - Repetitive Traction Injury**

4 layers of arch muscles (intrinsic/extrinsic)
Control the deformation with each footstrike
Muscles are just one part of the core

**Foot Core System**

*Based on Panjabi’s Lumbo-pelvic Core System Model

**Need Integration of all three for normal function**

Need Stability (intrinsic) and Mobility (extrinsic)

**Passive Subsystem – Bony Structure**

4 Aches coalesce:
- Med. Longitudinal
- Lat. Longitudinal
- Ant. Transverse
- Post. Transverse

Arch Modeled as a half dome*

*McKenzie, 1955
Passive Subsystem - Ligaments

4 Layers of Intrinsic Foot Muscles
1. Abd Hallicus
2. Fl Dig Brev
3. Abd Dig Min
4. Quad Plantae
5. Lumbricals
6. Fl Dig Minimi
7a. Add Hall Oblique
7b. Add Hall Transv
8. Fl Hall Brevis
9. Plantar Interossei
10. Dorsal Interossei
11. Ext Dig Brevis

Extrinsic Muscles (tendons)

Flexor Digitorum Longus

Peroneus Longus

Extensor Hallicus Brevis

Note difference in muscle size from plantar intrinsics!
Plantar Fascia – Last line of defense!

As tension increases in the achilles – so does that in the plantar fascia

Importance of Intrinsic Muscles

Fatigue of Intrinsics results in increased navicular drop
Headlee et al, 2008

Tibial nerve block resulted in decreased AH activity and increased navicular drop
Fiolkowski et al, 2003

Neural System

Plantar sensation has been shown to be critical to gait and posture

Increased static postural stability in BF compared with socks!

Foot Assessment

Assessing the Extrinsic Foot Muscles can be done in a variety of ways

Increased dynamic postural stability in BF
Foot Core Assessment

A recent systematic review concluded that there is no gold standard. Soysa et al, 2012

Be Creative

Dome Strength  Hallux Strength  Lat. Toe Strength

Foot Core Assessment

Imaging

MRI  Ultrasound

Abductor digiti minimi  Quadratus plantae  Flexor digitorum brevis

Foot Core Training

Functionally

Standing  Running

Foot Core Training

Foundational Strength

Doming  Abdominal Draw In  Augment with estim

McKeon et al, 2015
Foot Core Training

Band Exercises

AFX video

Foot Core Training

Functional Strength

Functional Strength

Single leg square jumps
Box Jumps
Jump rope

Always do exercises barefoot!

Foot Core Training

Barefoot/Minimal Footwear Walking/Running

Feet shortened with BF walking and running
Robbins and Hannah, 1987
X-sectional areas of foot ms increased with minimal shoe use
Bruggeman et al. 2005
X-sectional areas of foot ms increased with minimal shoe use
Miller et al. 2014

You can change arches!

32 yr old runner, longstanding hx of Plantar Fasciitis and Post. Tib. Tendinitis – longstanding history of orthotic use
Weaned out of orthotics, running in minimal shoes and doing Crossfit
Future – Stretchy sensors

Measurement

Feedback

Barton et al, 2015

Railford et al, 2014

Does Footwear Matter?

2005

2009

2010

2012

2013

Examining injury risk and pain perception in runners using minimalist footwear

Michael Noyes, Mike Skoog, Richard Kauzer, Seth Yarnell

N=33

N=33

N=33

Results

“The partial minimalist shoe reported a significantly higher rate of injury incidence throughout the 12-week period”

Does Footwear Matter?


Partial minimal shoes more similar to traditional shoes than to BF

2. Squadrone and Gallozzi, 2009

What about Highly Cushioned Shoes?

Vertical Instantaneous and Average Loadrates

Peak Tibial Shock

Novice Hoka Users

Novice/Habitual Hoka Users

Land Harder on Soft Surfaces

Bishop et al, 2006

Ferris et al, 1988, 1999

Why not just FFS in Cushioned Shoes?

Increased PF and INV in runner with insertional achilles tendinitis

Dec. PF and INV
Loadrates: FFS in cushioned vs minimal shoes

Loadrates are lower across all components of the Ground Reaction Forces

Footwear/Footstrike across a marathon

What Constitutes Minimal Footwear?

No motion control
No cushioning
Zero drop
No arch support
No midsole

Shoes of Ron Hill, 1970
Winner of Boston Marathon

These will promote a BF style

The story of the kids of Koh Panyee, Thailand

Let's Start Strengthening Feet!

Find your strength

Thank-you