Clinical MSK (Foot) Assessment Tests: the good, the bad & the ugly

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Concerning Pronation

- Pronation means to take up a prone position.
- Pronation is essential for plantigrade bipedal gait.
- Pronation allows initial compliance and later passive foot stiffening.
- Hyperpronation has been philosophically but not quantitatively defined. Horwood & Chockalingam, 2017.
- Attempts have been made to semi-quantitatively define hyperpronation. (FPI)
- The link between pathology and hyperpronation remains unclear because too many problems do not link.
Variation in pronation (evertors)

Types of *eversion* in gait.
Four recorded patterns in asymptomatic humans:

1. Typical
2. Delayed
3. Prolonged
4. Early

Cornwall & McPoil, 2009
Foot pronation defined

A definition of motion **not** a description of motion.

Motion of the foot articulations that allow the foot to become more prone to the support surface thereby increasing the ground contact surface area of the foot.

■ Horwood & Chockalingam, 2017
A range of motion within the foot that makes the foot more prone to the support surface that is greater than that required by the individual to adjust to morphology or to deal with the forces placed on the musculoskeletal system by kinetic and kinematic events within gait or another given action.

Horwood & Chockalingam 2017
What are we seeking from clinical examinations

- Diagnosis.
- Potential abnormalities that link to pathomechanics of pathology.
- Does this require us to have normals to work from?
What are we looking for on clinical examination?

Maharaj et al, 2017

Looked for the causes of overuse injury used modeling using 11 variables.

- Approx. 46% of kinematic variance and 37% energetic variance comes from arch height ratio, foot length and step width.

- Concluded that soft tissue structures in a flat-arched mobile foot are at greater risk of injury as they have greater requirements to absorb energy and generate larger forces. These associations are only moderate, other measures may also have an influence.
This lecture

- Concepts of Reliability & Validity
- Subtalar Neutral Position
- The Arch Index
- Foot print indices
- Navicular drift
- Longitudinal arch Index
- THE FPI: **Practical** (maybe)
- Ankle Dorsiflexion: **Practical**
- The Hubscher manoeuvre / Jacks test: **Practical**
- The Supination Resistance Test: **Practical**
- Cyriax: **Practical**
For a clinical test/measurements to be meaningful it must achieve two important criteria:

1. **Reliability** is the ability to take a measurement on repeated occasions and get the same measurement. That does not mean it is of any use.

2. **Validity** means the test/measurement gives you information that can be used to establishes useful facts (diagnosis or instruct-change treatment plans).
Key objectives in clinical testing is …..

- To identify the pathology troubling the patient (diagnosis).

- To identified abnormal situations from normal.

- Important to distinguish clinical abnormalities from examination errors.
The awkward facts

- The key examinations used to make inferences about dynamic foot function and to determine orthotic prescription are unreliable.

Jarvis et al, 2012
Root et al approach: SUB-TALAR NEUTRAL POSITION etc.

RCSP and NCSP, very poor intertester reliability.
1st ray motion poor to moderate.

Accuracy of measurements not achievable.
Not possible to identify normal from abnormal.

"Using these examinations to differentiate normal from pathological foot function would not appear to be valid clinical practice".

BUT IS STJ NEUTRAL IMPORTANT ANYWAY???????

No evidence for association with pain or dysfunction
Gates et al, 2015
Dorsal height taken at 50% length of entire foot and divide by the length between the posterior heel to the 1st metatarsal head to derive index (Williams & McClay, 2000).

or you can use total foot length unless toe deformities (McPoil et al, 2008).

AHI taken sitting (10% bw) to standing to reflect weightbearing (50% bw) and arch stiffness. The difference in measures represents the stiffness.

Longitudinal arch angle is reported to be positively correlated with dynamic longitudinal arch angle, and strongly associated with radiographic measures of arch height. (reliability)

Curvilinear relationship noted between body mass% and arch deformation. (Bjelopetrovich & Barrios, 2016)
• Good inter and intra tester reliability. Fraser et al, 2017

BUT

NOTE: first question….is there a desirable arch height?????????

■ It’s a static measure.
■ No correlation between arch height and dynamic maximum eversion of rearfoot.
■ No correlation between arch index to disabling foot pain, balance, gait function, or falls (Gates et al, 2015).
■ Classifying foot type to height to length ratio shows no relationship (Hill et al, 2017)
FOOT PRINT INDICES

Uses footprints or pressure mats printouts to map out contact areas

- Arch index from ink prints and pressure mats different (Urry & Wearing, 2005).
- Relationship poor to fair (low arch = more medial midfoot, hallux pressure, lower medial forefoot) (Jonely et al, 2011).

Link to pathology? Is there a ‘normal’ arch?
Two lines between most prominent point medial 1st metatarsal and medial malleolus with apex at navicular tuberosity. (Feiss in 1909 first to suggest it)

120-150° ‘normal’ but disagreement. (McPoil et al, 2016)

Highly predictive of foot posture at midstance (McPoil & Cornwall, 2005; McPoil et al, 2016).

BUT

Inter-rater reliability issues (McPoil et al, 2016)

Validity to pathology or treatment?
Conclusions on arch measures:

- Static and dynamic arch angle can correlate.
- No correlation between arch height and dynamic maximum rearfoot eversion.
- No correlation between arch height and foot pain in older individuals.
- No correlation with arch height and balance, function or falls.

Navicular Drop

Height of navicular tuberosity in talar head congruentancy position to relaxed stance position!

■ Strong association with radiographic arch height on stance at RCSP.
■ Associations with gait function & balance tests, and walking speed.

BUT

■ No significant correlation with foot pains or falls.
(Gates et al, 2015)

■ What is ideal drop? (Menz, 1998)
NAVICULAR DRIFT

- Adds in transverse plane motion as well as sagittal (Menz, 2005).

- ... all the validity problems of navicular drop!
• Multi-foot segment & multiplanar.
• Good intra-rater reliability but only moderate inter-rater reliability. Cornwall & McPoil, 2008
• with training: good inter-tester Fraser et al 2017
● Predicts only 41% of dynamic foot position variation (Redmond et al. 2006).

● Asymptomatic groups; larger feet have lower FPI; taller and heavier people higher FPI (57% in normal group) (Rodriguez et al, 2013).

● More mobile feet have a higher FPI (Cornwall & McPoil, 2011).

● No association with disabling foot pain (Gates, 2015).

● No associations between fallers and non-fallers. (Menz et al, 2006).
Other possible uses for FPI

- As an assessment tool of rehabilitation/treatment success.
- Evaluation of foot orthosis position.

Changes in foot posture after 60 mins of running at 3.3 ms causes increased scores if foot posture. (Escamilla-Martinez et al, 2013)

BUT USE WITH EXTREME CAUTION!
ANKLE DORSIFLEXION (PLANTARFLEXION?)

- Ankle flexibility associated with balance and function tests in older populations.
- Noticable difference in fallers to non-fallers
- Associated with Charcot's in diabetic neuropathy.
- Not associated with foot pain in general populations.
Moderate intra-tester reliability for maximum range. Poor inter-tester reliability by up to 10.7 degrees. Jarvis et al, 2012

Weightbearing and non-weightbearing measures should not be used interchangeably.

More weightbearing motion than non-weightbearing.

Weightbearing measurements of ankle dorsiflexion probably more appropriate for estimating ankle DF during gait. Kang & Oh, 2017
Joint Excursions & Joint Play Measures

Standing Ankle dorsiflexion good inter-intra tester reliability

1st MTP dorsiflexion good

Subtalar and Forefoot Frontal Plane measurements poor

1st metatarsal excursions (dorsal-plantar glide) acceptable

Joint Play Measures Poor, but better (53% repeatable) in more experienced.

Fraser et al, 2017 (2 examiners)
1st MTP/ Hubscher manoeuvre / Jacks Test

- Associated with increased sway & walking speeder in older people (Menz et al, 2005)

Passive weight bearing and non-weightbearing do not correlate.

No correlation between Hubscher/Jacks and 1st MTP range of motion during gait. (Halstead & Redmond, 2006).

- No significant link between 1st MTPJ ROM and disabling foot pain.

- No link to poor 1st MTPJ ROM and fallers and non-fallers (Gates et al, 2015)
SUPINATION RESISTANCE TEST

■ Finger pressure poor reliability when correlation with mechanical device. (Noakes & Payne, 2003)

■ What does it tell you??

The accuracy of the mechanical device unknown.

■ No association with pain or function (Gates et al, 2015).
Leg length discrepancy

Not reliable in measuring an amount of difference particularly under 5mm.

Marginally reliable at identifying the same leg as shorter between clinicians.

See Jarvis et al, 2012 paper again.
Only FPI, navicular height and arch height index have shown any degree of concurrent validity. Gates et al, 2015

These seem to be of limited benefit to understanding pathology.
How about muscle strength/flexibility testing????

What can my patient do?

Short foot exercises in stance produce around AbHal 73% of Max Vol Isometric Contraction and 43% sitting Jung et al, 2011
Muscle strength Testing

**Short Foot Exercise & Toes exercises** (except lesser toe extension). Fair to excellent intertester agreement.

Using a hand-held dynamometer good to excellent reliability

Fraser et al, 2017
Cyriax Testing For Diagnosis

- Different tissues do different things.
- Different structures tend to be injured by specific stress/strain events.
- Most tissues are anisotropic

Things that upset tissues and cause pain in pathological situations

- Joint surfaces = compression and shear
- Tendons, ligaments and fascia = tension under activation (especially with torque)
- Bone = torque & bending moments
- Muscles = isometric and concentric contraction rather than eccentric
- Nerves = under compression or compressed tension.
In support of Cyriax

An indication of the tissue structure injured.

Correlation with diagnostic image good.

Medial Ankle Pain

Active inversion/ resisted eversion pain

Passive eversion pain
Medial Knee Pain

Varus Compression for DJD

Valgus tension for medial collateral
● What do my clinical tests tell me?
● How does my clinical test change my treatment plan?
● How do I know that the test I’ve done has told me what I think it has told me?
● Can I support my argument to use this test rationally and/or with evidence?

**READ: 2 papers by Gates et al, 2015**

- [www.jhsr.org/IJHSR_Vol.5_Issue.2_Feb2015/15.PDF](http://www.jhsr.org/IJHSR_Vol.5_Issue.2_Feb2015/15.PDF)
- [www.Southampton.ac.uk/assests/centresresearch/documents/wphs/LGAN%20evaluation%20of%20musculoskeletal%20foot.pdf](http://www.Southampton.ac.uk/assests/centresresearch/documents/wphs/LGAN%20evaluation%20of%20musculoskeletal%20foot.pdf)
References