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Function: the foot bone is connected to the head bone! Functional Evaluation (Part 1)

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Introduction
Objective

To stimulate critical thinking about the role of tri-plane function in the evaluation and treatment of neuromuscular injuries

Objectives...

The participant will be able to:

➢ Identify at least 5 new tests for a functional evaluation in 3 planes of motion.

➢ Describe at least three components of a chain reaction of gait; foot to pelvis in function.

➢ List at least three functional road blocks that can limit treatment success starting from the initial evaluation.
Function

What is it?

Function

Multi-planar
Reactionary
Dynamic
Subconscious
Integrated
Total Body
With neurological issues we have tended to look more globally for function…

But with orthopedic issues too often we view function locally

Our patients have both a neurologic as well as an orthopedic component

Hence the term neuromuscular!
Function is about movement that is pain free and balanced in 3 planes of movement!

We work in 3 planes of motion at each joint & muscle group to varying degrees
What do we use when we need more force? We get rotation!

It’s all about transverse plane!
In function we want to work in safe extremes of motion to optimize both Concentric & Eccentric length in 3 planes

How do we do it?

Eccentric Loading

How do you load a muscle?

You stretch it in all 3 planes

Eccentric Loading

Concentric Explosion
They are inter related not mutually exclusive, need one to get the other!

Concentric (shortening) leads to Eccentric (lengthening) leads to Concentric…
Eccentric loading: right leg, hip & left trunk, shoulder

Gluts eccentric loading to lower

Concentric explosion to stand up!
Function for the Gluteus Maximus is in a 45 degree transverse plane line

Why do we treat it as a sagittal plane muscle?

Evidence:
Dierks et al investigated and positively correlated the relationship between weak hip external rotation and patellofemoral pain in runners with a measurable increase in hip adduction during running. At the end of the run, the association between hip abduction strength and peak hip adduction angle was statistically significant for weakness in the PFPS subjects.

Dierks TA, Manal KT, Hamill J, Davis IS 2008
How Does This Relate To What We Know Of Function

Tri-Plane Function

Multi-planar
Reactionary
Dynamic
Subconscious
Integrated
Total Body
Patient Evaluation
Do what you know but add a functional twist!

Cross Relationships

Patient Evaluation
Posture
Gait
Relative Motion
Cross Functional ROM
What can decrease the quality of function?
Poor posture

Posture Assessment
What are the clues for function?
If our posture is our basis for motion

Can we and do we move in 3 planes?

Posture Assessment

What clues could tip you that there may be a lack of transverse plane motion?
What We See Clinically:

- Postural imbalances of the trunk
- Excessive/unchanging pronation or supination of the mid-foot
- Static hip external rotation
- Forward incline of trunk and head
- Primary plane is sagittal or frontal
- Low core tone

Posture
If our power comes from transverse plane how does the presenting posture give clues to movement?

If the body rests in extremes of motion, we may not be able to achieve relative motion.
What can decrease the quality of function?
    Poor posture?
    Lack of rotation in gait?

What Is More Functional Than Gait?
Patient Evaluation

Do what you know but add a functional twist!

Gait assessment for all patient diagnoses

Chain reaction during gait

1. Heel strike results in calcaneal eversion
2. Calcaneal eversion drives the midfoot down/in to load 1st MTP
3. Calcaneal eversion initiates tibial IR and eccentrically loads the soleus
4. Tibia’s internal rotation unlocks the knee to start femoral IR
5. Action of femoral IR/flexion/adduction eccentrically loads the gluts
6. Loaded Soleus talks to loaded gluts for deceleration help
7. Loaded Glut explodes to control speed of femoral IR & weight shift
8. Trunk counter rotates with arm swing & loads abs
9. Opposite psoas gets a stretch into extension and dynamic loading
10. Other leg swings forward at end of stretch to repeat process
Gait analysis gives important clues regardless of the diagnosis

If we assess gait we have a good start to determine function from the foot to pelvis

Gluteal Family: Maximus, Medius, Minimus

Degrees of External Rotation…
In normal function…
The gluteus maximus acts as the primary decelerator in the transverse plane during gait.

In abnormal function…
In the absence of the gluteals & abdominals the psoas steps in as a stabilizer for the pelvis & trunk which causes a long term load block to function.
Gait Assessment

Natural (sagittal)
Toes in (transverse)
Toes out (transverse)
Crossover (transverse)

Tri-Plane Assessment
Start with gait sequence
If I see…
I’ll check…
What We See Clinically:

- Flat foot heel strike
- Excessive, unchanging pronation or supination
- Static hip external rotation
- Absent or poor hip/trunk rotation
- Absent or poor arm swing
- Forward incline of trunk and head
- Primary plane is sagittal or frontal
Evidence:

Dierks et al evaluated 2 groups of 20 runners, one group with PFPS measuring and analyzing kinematic data. The PFP group displayed atypical motions of hip valgus and hip abduction during the first part of the run. Three subgroups were identified for the PFP group for unique kinematic form. The knee valgus group displayed increased knee valgus with decreased motion in other joints. The hip abduction group exhibited less knee flexion and overall motion. The knee and hip adduction group, were noted to exhibit greater hip internal rotation and a decrease in knee internal rotation. This supports the variety of kinematic changes that occur with pain avoidance.

Where do you find limitation in rotation?

If not rotating…

  can’t load muscle…

  can’t activate core/butt…

  psoas will compensate!
What am I looking for?

Be consistent with how you evaluate gait

Look at the foot and move up

Or

Look at the trunk and move down

What am I looking for?

Is there rotation from the foot through the trunk/pelvis?

Is the gait pattern efficient in 3 planes or does one plane dominate?

Do you see relative change between extremes of range of motion?
From the feet up:

*Feet static pronation or supination?*

*Hips externally rotated?*

*Trunk rotation?*

*Arms swinging?*

*Which plane of motion is dominant?*

*Change in pain with variations?*

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From the head down:

*Arms swinging?*

*Trunk rotation?*

*Pelvis rotating?*

*Hips external rotated?*

*Feet static in supination or pronation?*

*Which plane of motion is dominant?*
What can decrease the quality of function?
Poor posture?
Lack of rotation in gait?
Poor foot function?
If the foot’s function is to accept ground reaction forces in gait… Can it accept them in 3 planes of motion?

Patient Evaluation
Do what you know but add a functional twist!

Reach Testing
Relative change…

Movement at feet is less than hips which is less than the shoulders/trunk
Relative change… *IF*

Shoulders are 100%
Hips are 50%
Feet are 25%
Relative Motion from the Foot through the Pelvis

In normal the mid-foot will lift into supination through eccentric loading of the gluteals with reaching across the body from the opposite side

ie reach across with the left hand across the right foot

Relative Motion from the Foot through the Pelvis

In normal the mid-foot will move into pronation as the foot through the hip moves into internal rotation with reaching across the body on the same side

ie reach across with the left hand across the right foot
Our body wants relative change between extreme ranges in motion.

Do you see relative change in the midfoot?

Pronation?  Supination?

Relative change…

Is there relative motion between the shoulders? Hips? Feet?

Do the hips move?

Can the hip stabilize with motion?

Do the feet move between pronation/supination?
Reach Testing for Relative Change…
Can they assume the SLS posture?
Can they move and maintain balance?
Is there more, less or the same motion at each level? Shoulders? Hips? Feet?
Is there relative change between pronation & supination?
Foot Posture

If the foot is supposed to start the process of transverse plane during gait, can it demonstrate relative motion in stance. If not probably is not happening in gait

Foot Variables To Observe:

Static Supination

Static Pronation

Dynamic & Unstable
What can decrease the quality of function?
   Poor posture
   Lack of rotation in gait?
   Poor foot function?
   *Lack of hip motion/strength?*

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**Sit Back Reach Test**

Tests eccentric strength by sitting back into the hip.
Reach straight down tests sagittal plane,
reaching across and down tests transverse plane
**Sit Back Reach Test**

- Reaching out will increase lumbar lordosis and activates the psoas cue to reach lower to soften the back to test the gluteals avoid “Lock and Load” of the spine

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**Single Leg Floor Reach**

- “Dipping Bird Test”

Tests eccentric control for gluteals, hamstrings & gastrocs
Hinge at the hip with a soft, not bent knee to allow the gluteals, hamstrings & gastrocs to lower the body eccentrically...then return to standing concentrically.

Reach down loads the glut/hamstring & gastroc

Reaching up loads the abdominals and concentric gluts
What can decrease the quality of function?
- Poor posture
- Lack of rotation in gait?
- Lack of hip motion/strength?
- Poor foot function?
- Excessive psoas tone?
Role of the Psoas in Function:

- Eccentrically for hip extension in contralateral swing phase
- Concentrically for swing phase, stairs, SLRs, kicking, etc.
- Vertical spine stabilizer

*psoas vs iliacus*

*iliacus performs pelvic posterior rotation for posterior tilt*

*Origin: Pelvic fossa 2/3, 1/3 iliac crest, SI*

*Insertion: joins with the psoas at the lesser trochanter*

*I innervation: L2-3, femoral nerve*
psoas vs iliacus
psoas stabilizes the spine and pelvis in the position of rotation

Origin: Lateral/anterior transverse processes of L1-5
Insertion: Joins with the iliacus at the lesser trochanter
Innervation: L1-3

When glut/abs are lax…
psoas kicks in

When psoas is tight…
the core/glut shuts down
The antidote for a tight psoas is a strong butt and core I used to beat up on the psoas…not now!

In gait the contralateral stride will be shorter resulting in a harder, foot flat impact at heel strike……
If the psoas is always turned on & over-worked…

Why would the core and the gluteals need to stabilize?
The Chain Reaction from the foot to pelvis can be broken and compensation patterns emerge

Hip lock with SLR may indicate tight psoas
Palpate 1” lateral to the umbilicus

Perform active SLR to confirm psoas location
Inhibit psoas and re-test SLR
Evidence: (Preliminary Data)

Davidson et al studied the correlation between the psoas and hamstring in a double blind study currently in process. The study is assessing the correlation between hamstring tightness with a SLR as compared to a SLR with psoas inhibition. In addition, this study is measuring the effectiveness in reducing hamstring tightness or increased SLR through the performance of various stretching exercises.


Preliminary Results
SLR/Psoas Study
n=5 male runners
Preliminary Results
SLR/Psoas Study
n=12 female runners

The world according
to me:
all roads lead to the Psoas!
Evaluation Summary

Posture Assessment
Increased spinal curves?
Hip external rotation?
Static pronation/supination?
Low core tone?
Pain location related to gluteal function?
Gait Assessment

Loss of transverse plane?
Hard impact with heel strike?
Lack of arm swing?
Increased spinal curves?
Hip external rotation?
Static pronation/supination?
Change in pain reports?

Reach Testing Summary

Loss of transverse plane?
Poor relative change from the feet through the hips?
Limited single leg stance balance?
Pain changes?
ROM Assessment

Restriction in hamstring/SLR?
Psoas/Hamstring correlation?

Eccentric Assessment

Sit back reach
Dipping Bird Test
(reaching floor level)
What can decrease the quality of function?
Poor posture
Lack of rotation in gait?
Poor foot function?
*Lack of hip motion/strength?*
*Excessive psoas tone?*

Questions?
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