THE ABC’s of LESSER MTPJ INSTABILITY

Anatomy, Biomechanics & Clinical Evaluation

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Just a hammertoe?
“Every foot has a story to tell.”

-rtb
PURPOSE

- Provide background info
- Review local anatomy
- Highlight key biomechanical concepts
- Present case study w/ review of pathomechanics
- Share clinical exam & tx pearls
- Stimulate further study
DEFINITION

Lesser MTPJ Instability refers to a loss of articular integrity resulting in a spectrum of pathologies.
Chronic 3\textsuperscript{rd} MTPJ Dislocation
AKA

- Overlapping-Toe, Crossover-Toe, Plantar-Plate Disorder, Pre-Dislocation Syndrome, Floating-Toe, Sub-2nd Syndrome, Wind-Swept Toes, Splay-Toe, Spread Foot, etc.
TYPES

✔ Sagittal Plane
✔ Transverse Plane
✔ Combined Planes
ETIOLOGY

- Trauma
- Attrition
- Iatrogenic
FACTORS (Mechanical)

- Hypermobile/Short 1st Ray
- HAV w/ Bunion Deformity
- Parabola Abnormality
- Metatarsal Malalignment
- Ankle &/or FF Equinus
- Other
FACTORS (Systemic)

- Rheumatic Disease
- Ligamentous Laxity
- Neuromuscular Disease
- Other
ANATOMY

- Bone/Joint
- Soft Tissue
  - Static
  - Dynamic
    - Intrinsics & Extrinsic
ANATOMY QUIZ

1) Single strongest deforming force?  **EDL**

2) Primary **digital** flexor?  **Interossei**

3) **Dynamic** digital stabilizers?
   **Intrinsic muscles:** interossei & lumbricales

4) **Static** digital stabilizers?
   **Capsule, collateral ligaments (ACL, PCL), plantar plate, plantar fascia**

5) What is unique about intrinsics to 2\textsuperscript{nd} digit?
   2 dorsal interossei, no plantar interossei, 1\textsuperscript{st} lumbricale medial
BIOMECHANICS

- Function of toes
- Windlass mechanism
- FF axes
- Tie-bar system
- Phasic muscle activity
- Gait kinetics
- First ray
FUNCTION OF TOES

- ↑ WB surface area of FF
- Help to stabilize arches
- Aid balance, movement & proprioception
WINDLASS MECHANISM

Hicks, 1954

WINDLASS

Arch raising
Hallux dorsiflexion force

REVERSE

Hallux plantarflexion force
Tension in plantar fascia

Hicks, 1954
FF AXES

“Forward prominence” of 2\textsuperscript{nd} met allows push-off about 2 axes:
1) Transverse or high-gear
2) Oblique or low-gear

Bojsen-Møller, 1978
TIE-BAR SYSTEM

Hicks' Truss

Transverse and longitudinal tie-bar system

Both systems tighten when weight bearing on forefoot

Haines, 1947; Hicks, 1955; Stainsby, 1997
28 yr. old female w/ acute dislocation x 2 recent steroid injections
IMPORTANCE OF TOES - Phasic Muscle Activity

- Passive & active mechanisms described
- Phasic activity of extrinsics & intrinsics established for walking & running

Mann, et al., 1979
IMPORTANCE OF TOES-Gait Kinetics (Walking)

- In contact for $\frac{3}{4}$'s of stance
- Exert pressures similar to metatarsals (25% of MPP-2nd toe)
- During 2nd peak of TF, area of ground contact ↓

Hughes, et al., 1990
Hughes, et al., 1990
FIRST RAY

Insufficient 1st Ray

Tripod of Foot

Morton, 1935; Cotton, 1936
FIRST RAY

Study: Dorsal directed load applied to transverse plane deviated & transverse plane corrected 1st metatarsals

Conclusion: When 1st metatarsal is aligned in transverse plane, windlass & PL can function more efficiently- 26% ↑ in 1st ray PF

Rush, et al., 2000
CASE STUDY

60 yr. old master’s tri-athlete co severe FF pain, deformity & dysfunction
Pathomechanics- FF Equinus
CLINICAL EVAL

- History
- Physical Exam
- Differential Dx
- Diagnostic Testing
HISTORY

- **CC**: Progressive symptoms w/ running & cycling
- **HPI**: 2\textsuperscript{nd} toe & MTPJ pain, deformity & weakness at toe-off, duration- 8 mos., no injury, ↑ interval running in minimalist shoes
- **PMH**: Unremarkable
Lachman’s or Drawer Maneuver
PHYSICAL EXAM

- Detailed exam- planes of deformity & MTPJ instability
- Predisposing factors
- Provocative tests: push-up, “footstool-edge,” Lachman, toe-off & toe purchase testing
DIFFERENTIAL DX

- Instability
- Fracture
- Bursitis
- Capsulitis
- Flex. Tendinitis
- Neurogenic
- Rheumatic
- Freiberg’s
- Chondral/OCL
- Capsule Sprain
- Digital Def.
- MTPJ: Extensus/ Abd-/Add-
- Plica
- Other
DIAGNOSTIC TESTING

- WB x-rays
- Stress views
- Arthrogram
- Harris pressure-mat
- Diagnostic injection
LACHMAN or Drawer Test

Lateral Oblique View
TRANSVERSE STRESS

ABD STRESS

ADD STRESS
HARRIS PRESSURE MAT
FRONTAL OR SHORT AXIAL

SAGITTAL VIEW

MRI
DIAGNOSIS - Left Foot

- 2nd Toe - Biplane Instability
- MTPJ w/ Synovitis
- PP Tear
- Lat. MTPJ Attenuation
- Rigid Hammertoe

- Ankle Equinus
- FF Equinus
- HAV w/ Bunion
- 1sr Ray Hypermobility
- Long 2nd Met w/ Malalignment
Pathomechanics - Sagittal Plane MTPJ

- Extensor longus tendon
- Dorsal hood aponeurosis
- Interosseous m.
- Lumbrical m.
- Lumbrical tendon
- Plantar plate
Pathomechanics - Transverse Plane MTPJ

“Bunion Deformity of LMTPJ”
CONSERVATIVE TX

- Tranverse Plane Deformity - digital spacers & metatarsal “binding,” bunion splint
- Sagittal Plane Deformity - manual stretching, digital taping/splinting
- Stabilize & Protect Foot - flatbed SLW boot → shoes (rigid, rocker soled) & orthoses
- Address Predisposing Factors
How would you address PREDISPOSING FACTORS?

- Ankle Equinus
- FF Equinus
- 1st Ray Hypermobility
- HAV w/ Bunion
- Long 2nd Metatarsal
WHERE DOES TOE SPACER GO?
Reference

Bouché, RT: Lesser MTPJ Instability in the Athlete: Conservative Care Options.
Pod Today, October, 2015
Conservative Care

SURGICAL TX

- Gastroc Recession
- Lapidus Bunionectomy
- Shortening/Transpositional 2nd Met Osteotomy
- PP Repair
- PIPJ Arthroplasty
PLANTAR PLATE TEAR
SUMMARY

- Accurate dx & rational tx is based on understanding of anatomy, biomechanics & clinical evaluation
- Know your ABC’s!