The Knee and Running Injuries

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What hurts us in treating patients with knee injuries is not what we know – but rather what we know that isn’t!

The Knee is basically in the lower extremity kinetic chain – stable joint above and below – forcing the knee to be the distributor – the dissipater of loads - requires the hip – thigh- lower leg to all function in proper sequence and effort level

Patellar malalignment – Big issue ... - Reality: statics don't predict dynamic problems well and when a unilateral presentation – what do you think the other side looks like? (hint – mirror image !)

What is the role of imaging – confirm our manual assessments

Always start with knee screen – to rule out the big issues and confirm what we expect!

Diagnostics – Ask the right questions – to get the right answers

Only get a MRI when it might alter our care – not just to confirm a possible diagnosis!

General data related to manual Assessment

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best test for:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACL Lachman</td>
<td>80-90%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>PCL Post. Drawer</td>
<td>51-90%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>MCL Valgus Stress</td>
<td>86-96%</td>
<td>(? 85%)</td>
</tr>
<tr>
<td>LCL Varus Stress</td>
<td>(? 50%)</td>
<td>(? 75%)</td>
</tr>
</tbody>
</table>
| Meniscus Single Wt.BRot   | 89%         | >90%        {But not in isolation !}

Screen clears the BIG THINGS – then we focus on the Running Activity and where it impacts the RUNNER!

Ideally on track – may use treadmill – both side view and posterior 2-D is clinical!
Don’t forget the BASICS (given to us by Tom McPoil, Lynn Wallace, Irene Davis)

The old Rules still apply

10% max increase per week

1 week per month is soft

Never do back-to-back challenge days

Need a rest day

Big 3 – Little 1

Pronation, Limb Length, and Flexibility - Strength

What we see at the Knee in Runners

PF Syndrome – Anterior Knee Pain – AKA – Runners Knee #1 - ~ 15% of all running injuries More common in females- Typically in higher running volumes – most often neuromuscular - demonstrate dynamic valgus collapse Treatment: Neuromuscular approach – very important to remember proximal!

Iliotibial Band Syndrome ~ 10% of all running injuries Now believed to be related to fat deposit that gets irritated  Treatment: Cryo, proximal focus strength and stretching (be reasonable!) Training modifications – often shorten the step/stride length – alter speeds – Be careful out there ...

Tendon Issues – Tedinopathy ~ 5% of running injuries Painful – inflammatory-like presentation BUT of a chronic nature – not a one time event If less than two weeks duration – deemed Acute > 2 weeks – Chronic Acute Treatment: Cryo, NSAID’s (for a couple of days!), Activity Modifications, eccentric maximals (relatively good outcomes) Chronic – As for acute treatment initially – but then major focus on eccentrics – 10-12 weeks required (outcome - less predictable!)

Menical Lesions 3-5% of running injuries (Often linked to osteoarthritis – meniscus is a hugely chondro-protective element - Presentation is catching, locking, tightness – pain “in the knee” Treatment: NSAID’s, Strength (open chain – 30-90 degrees- no jogging – run on ball of the foot – may use 10-50-10 sequence Arthroscopic surgery MAY be required – MAY !!!
Osteoarthritis

Relatively rare – when seen often related to previous injury – often meniscus removal
Opinion: rare that it develops because of the running itself
Management is multifactorial: But nearly always includes significant volume control – strength (total lower extremity), be very cautious in use of medial arch support – may try lateral wedges – hip and knee distractions ...

Remember: sometimes it is easy – Sometimes it is hard!

Thank you for your attention and thanks to the Section for their support!

Enjoy the weather!
“Normal” Running Mechanics
Ben Keeton, PT, DPT, OCS

Overview
- Phases of Running
- Mobility Needs
- Stability Needs
- Cadence
- “Normal” is relative!

Gait Cycle
- Stance Phase
- Swing Phase
Stance Phase
Mobility Needs

- Talocrural Joint
  - IC = 10 degrees DF
  - MS = 20 degrees DF
  - TO = 25 degrees PF
- Subtalar joint
  - IC = 5-10 degrees inv
  - MS = 10 degrees ev
  - TO = 0-2 degrees inv.

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Stance Phase
Mobility Needs

- 1st MTP
  - TO = 60-70 degrees Dorsiflexion

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Stance Phase
Mobility Needs

- Knee
  - IC = 30-40 degrees flex
  - MS = 50-60 degrees flex
  - TO = 20-40 degrees flex
Stance Phase
Mobility Needs

- Hip
  - IC = 50 degrees flex
  - MS = 20 degrees flex
  - TO = 10 degrees ext

Stance Phase
Mobility Needs

- Pelvis
  - IC = 5 degree tilt toward suspended leg
  - MS = Pelvis level
  - TO = 5 degree tilt toward suspended leg

Stance Phase
Mobility Needs

- Trunk
  - IC = 5-10 degrees flexed
  - Absorption = increases 2-5 degrees
  - TO = same as IC
Stance Phase
Stability Needs

Swing Phase
Mobility Needs
- Talocrural Joint
  - Throughout swing = Remains 10 degrees DF
- Knee
  - Throughout swing = Achieves a max of 130 degrees flex
- Hip
  - Throughout swing = Achieves a max of 60 degrees flex
Cadence
- Stance time should be as long as possible without minimizing the elastic recoil. [Dicharry 2009].
- 180 contacts per minute is “gold standard”

Normal is Relative!
- Heel or Forefoot Strike?
- Shod or Barefoot?
- Many other factors to consider when interpreting “normal”

Additional References
- Dean JC, Kuo AD. Energetic costs of producing muscle work and force in a cyclical human bouncing task. J Appl Physiol, January 6, 2011
Objectives

• Summarize the normal and abnormal running kinematics and kinetics for the lumbo-pelvic region and lower extremity.

• Integrate the pathomechanics with injury patterns hip.

• Synthesize an evaluation and intervention plan for those with running related injuries of the hip.

• Integrate anatomical, biomechanical and neuromuscular concepts relating to the etiology, examination, and intervention strategies for individuals running related injuries.

Injury Pattern

• Common Problems
  – Anterior/ Groin
    • Labral Tear
    • Pubalgia
    • Adductor Strains
  – Lateral
    • Trochanteric Bursitis
    • Gluteus Medius/Minimus Tendinopathy
  – Posterior
    • Sub-Gluteal Nerve Entrapment
Common Cause of Labral Tear

- Femoroacetabular Impingement
- Instability

Femoroacetabular Impingement
FAI

- CAM
- Pincer

Femoroacetabular Impingement
FAI

- CAM
  - Cam impingement results from an abnormal bump, thickening, and/or loss of femoral-head neck offset
Femoroacetabular Impingement
FAI

- CAM
  - Cartilage injury occurs as the cam deformity enters the hip to causing shearing forces and cleavage type lesions to the articular cartilage
  - The transitional zone and labrum will also be susceptible to injury when compressed by the cam deformity
  - The location of injury will depend upon the location of the deformity and the direction the hip is moved. Cam deformities are most often found at the anterior-superior head-neck junction

Pincer: FAI

- Pincer type impingement is an acetabular deformity that results in femoral head over-coverage
  - Global over-coverage (profunda and protusio)
  - Focal over-coverage
    - Superior focal over-coverage
    - The anterior and superior acetabular rim extending laterally over the femoral head.
  - Excessive acetabular retroversion
    - Anterior over-coverage but posterior under-coverage of the femoral head.
    - Internal rotation of the hip in 30-60º of flexion will cause the head-neck junction to come into contact with anterior labrum.
  - Excessive acetabular anteversion
    - Posterior over-coverage will cause the head-neck junction to abut the posterior labrum when the hip is externally rotated in extension.

Pincer: FAI

- Pincer type impingement is an acetabular deformity that results in
  - Causes edge loading type labral damage
  - Can also lead to subtle posterior subluxation of the femoral head with resulting in posterior contra-coup acetabular chondral damage
**FAI**

- **CAM and Pincer deformities** often occur together
- **Femoral version**
  - Retroversion:
    - The anterior-superior head-neck junction will be closer to the anterior rim of the acetabulum.
    - The anterior-superior labral may be at risk for compression from the femoral head-neck junction with movements that incorporate hip internal rotation in 30-60º of flexion.
  - Anteversion
    - The posterior head-neck junction is closer to the posterior rim of the acetabulum.
    - Therefore the posterior-superior labrum is at risk for injury with movements that incorporate external rotation in extension.

**Bony geometry**

- **Femoral Anteverision/ Retroversion**
  - Gait
    - Toeing in- Anteversion
    - Toeing out- Retroversion
  - Craig’s test
    - 15º Internal rotation normal
      - > 15º Anteversion
      - < 15º Retroversion
  - ROM
    - Increase internal rotation/ Decrease external rotation
      - Anteverision
    - Decrease internal rotation/ Increase external rotation
      - Retroversion

**Hip Instability**

- **Ligamentous**
  - Global
  - Focal Rotational
- **Labral Tears**
- **Dynamic/ Muscular Weakness**
- **Osseous**
  - Acetabular Dysplasia
Interaction

- FAI
  - Labral Tear
  - Loss of suction
  - Leads to instability
  - Pain
  - Weakness/Compensations/Dysfunctions
    - Adductor
    - Trochanteric Pain Syndrome
    - Sub Gluteal Nerve Syndrome

Adductor Longus

Weakness Impacting Mechanics
Gluteus Medius
**Link to Proximal Problems**

- Lumbo-Pelvic Instability/Weakness
- Sacroiliac Joint Dysfunction
- Pubalgia

**Athletic Pubalgia/ Sports Hernia**

- Term describing a spectrum of chronic pubic/inguinal pain
- A sports hernia, also known as athletic pubalgia, is a tear in the muscles of the lower abdomen.

- There are different theories about how this hernia occurs.
  - One possibility is that tight or strong hip flexor muscles tilt the pelvis forward and stretch the lower abdominal wall muscles, eventually leading to small tears in the muscles and tissues.
  - Repetitive forces to pubic symphysis or tendinous insertions of the adductors and rectus abdominus
  - Disruption of inguinal canal components (external oblique aponeurosis, conjoint tendon, etc.)
  - Often noted in athletes participating in sports that require forceful, repetitive twisting and turning
ATHLETIC PUBALGIA

- **Symptoms:**
  - Chronic pain, often occurring only during exertion.
  - Often described as sharp burning pain localized to the lower abdomen and inguinal region, that later radiates to the adductor region and potentially testicular region.

PAIN PRESENTATION IN ATHLETIC PUBALGIA

1. Hip vs Lumbosacral Spine
2. Extra vs Intra-Articular
   - Traumatic Impingement
   - Hypermobility
   - Hypomobility

Eval and Treat Lumbosacral Pathology
Eval and Treat Extra-Articular Pathology
Hip Region: Injury Patterns, Evaluation Considerations, and Intervention Strategies

Hip vs Lumbosacral Spine

- Special Tests
  - Lumbar ROM
  - Pelvis Landmarks
  - Standing Flexion
  - Long Sit
  - Prone Knee Flexion
  - Spring Testing

Intra- vs Extra-articular Pathology

- Special Tests
  - FABERS
  - Scour Test
  - Flexion/Internal Rotation/Adduction Impingement Test

Intra- vs Extra-articular Pathology

- Diagnosing Intra-articular pathology:
  - Insidious onset of sharp or aching groin pain that limits activity.
  - Physical examination:
    - Limited hip flexion, internal rotation, and abduction range of motion
    - Positive Flexion-Adduction-Internal Rotation Impingement test
    - Positive FABER test

- Recommendation in FAI:
  - B grade: Evidence levels 2 and 3
    » Philippon MJ (2007) Traumatol Arthrosc
Evaluate and Treat Extra-Articular Pathology

- Special Tests
  - Modified Thomas Test
  - Ober’s Test
  - Palpation
  - Resisted Testing

Craigs Test

Classification System for Physical Therapists

- Lumbosacral
- Extra-articular
- Intra-articular
  - Impingement
  - Hypermobility
  - Hypomobility
  - Traumatic
Classification Based Treatment
Lumbosacral

- Mobilization
- Strengthening/Stabilization
  - Include in all activity
    - Running Posture

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Pelvic and Trunk Stability

- Gluteus Medius
- Quadratus Lumborum
- Erector Spinae
- Abdominals

- i.e. Scapula stabilization

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Classification Based Treatment
Impingement

- Work within the Pain-free limits
  - Sagital
  - Frontal
- Gluteus Medius Stabilization
- Trunk Stabilization
- Joint Mobilization
  - Inferior
  - Posterior
Joint Mobilization

• Post capsule
• Distraction

Classification Based Treatment
Hypermobility

• Hip Stabilization
• Proprioception
• Gluteus Medius Strengthening
• Trunk Stabilization

Strengthening

• Monster walk
• Lunging
Strengthening

- Ball extension
- Ball flexion

Correction Position Faults

- Walk with Internal Rotation
- Step with Internal Rotation

Overview

- Common Problems
  - Anterior/ Groin
    - Labral Tear
    - Pubalgia
    - Adductor
  - Lateral
    - Trochanteric Bursitis
    - Gluteus Medius/Minimus Tendonopathy
  - Posterior
    - Sub-Gluteal Nerve Entrapment
**Combined Sections Meeting 2013**

San Diego, CA  January 21 – 24

Running Injuries
Current Concepts Related to Pathomechanics, Injury Patterns, Evaluation Considerations, and Intervention Strategies

Foot and Ankle Region

Stephen Paulseth MS PT DPT SCS ATC

**Objectives**

- Outline the injury patterns for the 3 functional units of the foot and ankle.
- Understand the requirements of landing and propulsion during the stance phase of running on the foot and ankle.
- Describe Midfoot/Forefoot and Hindfoot Instabilities and the subsequent related pathologies in runners.
- Understand the importance of a thorough evaluation of the foot and ankle including running gait analysis.
- Understand potential effects of non-optimal function, inefficiencies, and static and dynamic postural problems.
- Get our patients to return to their running training regimen ASAP without a problem!

**Functional Units of the Foot**

- **Hindfoot:** Tib-Fib, Talus and Calcaneus
- **Midfoot:** Navicular, Cuboid and 3 Cuneiforms
- **Forefoot:** Metatarsals and Phalanges

**Landing Impact / Force Attenuation**

**Determinants:**
- Running velocity: Foot strikes avg 600 times/km
- Body mass
- Touchdown kinematics
- Shoe properties
- Surface properties/gradient

**Stance Phase Kinetics**

**Hindfoot strike**

**Forefoot strike**

**Runner Injury Locations**

(Taunton et al 02)

<table>
<thead>
<tr>
<th>Location</th>
<th>Total (n)</th>
<th>Percentage of population</th>
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<tbody>
<tr>
<td>Knee</td>
<td>842</td>
<td>42.1</td>
</tr>
<tr>
<td>Foot/ankle</td>
<td>336</td>
<td>16.9</td>
</tr>
<tr>
<td>Lower leg</td>
<td>257</td>
<td>12.8</td>
</tr>
<tr>
<td>Hip/pelvis</td>
<td>218</td>
<td>10.9</td>
</tr>
<tr>
<td>Achilles/calf</td>
<td>129</td>
<td>6.4</td>
</tr>
<tr>
<td>Upper leg</td>
<td>105</td>
<td>5.2</td>
</tr>
<tr>
<td>Low back</td>
<td>69</td>
<td>3.4</td>
</tr>
<tr>
<td>Other</td>
<td>44</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2002</td>
<td>100</td>
</tr>
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</table>

5 most common Dx:
- Patellofemoral pain syndrome
- Iliotibial band friction syndrome
- Plantar fasciitis
- Tibial stress fracture
- Knee meniscal injuries
Normal vs Abnormal Running Gait

Impact/Landing Phase

Midfoot Injury Patterns

- Barefoot running with a forefoot strike pattern affords increased sensory feedback from the foot-ground contact and increased energy storage in the arch.
- Maximum foot deformation during gait occurs at the time of maximum ground reaction force.
- Forefoot sagittal and frontal plane motion patterns via the talonavicular joint were linked to the collapse of the medial longitudinal arch.

Factors associated with multiple stress fractures were high longitudinal arch of the foot, leg-length inequality, and excessive forefoot varus.

- Plantar arch helps to maintain subtalar rigidity for powered plantar flexion during toe-off and absorbs some impact force.
- During running, the elastic structures of the plantar arch function as a spring, returning approximately 17% of the energy generated during each stance phase.

Midfoot Instability: Compromised Propulsion?

- Pes Planus??
- Midfoot Sprain:
- Adult Acquired Flatfoot Deformity:
- Midfoot Valgus, forefoot abduction, first ray elevation

First metatarsal movement occurs at the end range of dorsiflexion and patients do not obtain full midfoot inversion at push-off following ACL.

- PTOD Occurs in 15% of population.
- MTSS predicted with 76% accuracy.

Midfoot Stability Evaluation Considerations

- History/PMH
- Functional outcome scale - FAAM
- Training schedule, intensity, mileage, speed

Static Assessment

- Wear patterns/calluses - shoes and feet
- Arch Height Index
- MMT: Gastroc-Solius, Tibialis Anterior
- Navicular Drop Sit-stand - foot varus/NCS/PRCSP - not validated
- 1st MT dorsal/plantar glides Good reliability/Validity, Clinical
- 3-D Midtarsal Joint mobility

Recipe for Failure?

Problems occur due to static and dynamic mechanisms affecting the foot and ankle.
- Exertion increases fatigue, alters kinetics and kinematics
- Instability may be due to prior injury, weakness of the limb, static and dynamic postural alignment “foot type”, or chronic mis-use.

Low arch runners
- Lateral Knee pain
- MTSS
- Soft tissue
- Reduced forefoot abduction excursion and velocity early stance
- Greater vertical ground reaction force load rates

High arch runners
- Lateral Knee pain
- Ankle and foot
- Bone
- Higher static medial arch in symptomatic PF runners

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Triplanar motion consisting of:
- Talor Dorsiflexion
- Talor Adduction
- CALCANEAL EVERSION: Easiest to measure clinically and experimentally
- Well documented that pronation is a factor(s) in running-related lower extremity injuries
- Pronation is NORMAL at slower velocities during 1st half of Stance/Landing

Related Pathomechanics include:
1. Contralateral pelvic drop
2. Femoral IR
3. Knee valgus
4. Tibial internal rotation
5. Foot pronation

What is the foot position while the body is converting forces between landing and propulsion?

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Foot Pronation

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Evaluation

Dynamic Assessment

- Functional ankle dorsi flexion ROM
- Bilateral heel raise vs Unilateral (balance and midfoot position)
- Dynamic Balance
- Overhead Squat
- Step Down
- Lunge with/without Rotation
- Lateral Heel Tap/Star Excursion
- Drop Land
- Gait Walk and Run

Hindfoot Instability

- Ankle sprain- mechanical laxity of hindfoot
- Foot posture
- Subtalar Instability - 10-25% of CAI
- Excessive Shank/Foot Ratio/Coupling-Supination or Pronation

Tarsal Delay

Propulsion Delayed?

Forefoot Instability

- 1st Ray dorsi flexion/ primus elevatus
- Prior trauma/sprain, PTTD, Fibularis function, FHL, pes planus, weakness

Results in possible:

- Hallux Limitus (35-60 % in those greater than 65 years) Zammit et al 09
- FHL / FHB tendinopathy- Knot of Henry Sebura et al 07, Richardson 87
- Metatarsal Stress fx Korpelainen et al 2001
- FHL tears Frick et al 84
- "Sesamoiditis" (involved in 12% of hallux injuries) Richardson 87
- Metatarsalgia

Tarsal Delay

Hindfoot : Shank Coupling

Distal Fibular A/WA glide over lateral talus

ATFL/PTFL fiber angle
Transverse plane stabilizers and transmit
Hindfoot : Shank coupling

Lateral talar trochlea
Fibular-talar glide surface

Talar/Tarsal Delay

Hindfoot/Shank Coupling

Functional Outcome of Ankle Sprain

- Horizontal ATFL/PTFL fibers control transverse plane motion at hindfoot via fibula/ankle
- Initial phase of LE/shank rotation can be delayed in hindfoot
- Magnitude of delay varies by foot type, laxity, prior injury
- Talar rotation > Tibial rotation
- Delay in ER is 0-10° and increases with PI
- Greater delay with additional ligament laxity Huson 2000, McKeon et al 09

If not treated over time can lead to

Ankle Osteo-Arthrosis

Forefoot Evaluation Considerations

Static Assessment

- Lesser MTP stability with drawer test
- Primus Elevatus- via WB radiograph
- Callus concentration
- 1st MT mobility- plantar/dorsi glides
- FHL strength varies with ROM
- Sesamoid mobility/position
- Forefoot position- varus/valgus
- Passive 1st MTP Plantar/Dorsis flexion in WB and NWB (functional limitus is difference)

Dynamic Assessment

- Gait analysis (42 degrees reported WNL)
- Standing heel raise test- uni/bi

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Hindfoot Evaluation

Static Assessment
- Hindfoot stability: Ligamentous laxity ankle and subtalar joints
- ROM/Joint mobility (HF/MF/FF)
- MMT/Strength - Soleus
- Foot posture/ Arch Height Index

Dynamic Assessment
- Functional ankle dorsiflexion ROM Knee-Wall
- Tibial Rotation
- Bilateral heel raise vs Unilateral (balance and hindfoot inversion)
- Dynamic Balance
- Overhead Squat
- Step Down
- Lunge with/without Rotation
- Lateral Heel Tap/Star
- Drop Land
- Gait Walk and Run

Interventions

Goal of treatment:
- reducing pain and inflammation
- reducing tissue stress to a tolerable level
- restoring muscle strength and flexibility of involved tissues.
- optimizing the patient’s running technique and training program

EVIDENCE
- Significant decrease in rearfoot/lower leg coupling variability during walking and running but not in individuals with functional ankle instability following a 4 wk balance re-training intervention. Neumuscular changes not laxity McKee et al 09
- Relationship between the hindfoot and tibia was more out-of-phase in the strike phase than the rest of stance in a group of runners. Hamill et al 99
- Proximal strengthening altered LE loading and reduced hindfoot eversion in 6 wks Snyder et al 09

Navicular Whip/ Manipulation (Thrust)

Vector – Straight Dorsal

Increased Tibialis Posterior strength following manipulation Paulseth et al 09

Cuboid Whip/Mob hand positioning

Vector – 45º Dorsal-Lateral

Commonly subluxated following lateral ankle sprain and enhanced Fibularis Longus strength following manipulation Lee et al, Shin, Warden 01

Lateral Subtalar Glides
Increase STJ eversion

Interventions

- Manual Therapy
- Stretching
- Taping/ Foot Orthoses
- Specific functional exercises
- Patient Education/ Coaching/Prevention/Gait technique training
- Surgical? Midfoot Instability: Radiographic talometatarsal angle greater than 15 degrees or 2mm displacement requires surgical intervention Myerson et al 86

Problems necessitate solutions!
Manual Therapy
Increase Dorsiflexion

DF Functional Mob
Posterior Talar Glide

Evidence for Anti-Pronation Taping

Changes foot and leg posture
• Increase in navicular height
• Reduced LE internal rotation
• Reduction in calcaneal eversion
• Alteration in plantar pressure (med to lat)
• 5% increase in longitudinal arch height during jogging to 33% change in calcaneal eversion during walking

Reduction in pain
• 20% immediately following application in individuals with plantar fasciitis
• 5-20% 1-7 days following application in individuals with heel pain
• Reduction in peak tibialis posterior and tibialis anterior EMG activity, 45% and 24% respectively.

Franettovich 2008
[29 articles were identified]

Sesamoid Mobs

• Hallux held in ~20° DF (variable)
• Proximal-Distal Glides
• Medial and Lateral Sesamoid glides
• Plantar flex 1st MT
• Orient 1st MT - Rotation?
• Forefoot supinated?

Tape effects

+ • Normalizes LE kinematics including foot position
• Alters kinetics including muscular efficiency, joint stiffness and stability
• Enhances proprioceptive function
• Reduces PAIN
• Treatment Directed Test prior to foot orthoses

- • Tape loses effectiveness in 10-30 minutes? Aur 91, Radford et al 06
• Mechanical properties of tape varies
• Skin irritation/allergies
• High-dye taping more effective than low-dye in controlling pronation

Vicenzino et al 05, Franettovich 2008, Vicenzino et al 05, Kelly et al 10, Bragg et al 02

Stretching

Stretching does not prevent running injuries (Fields at al 10)
BUT Stretch:
• to Improve Movement Patterns, Prepare for Running
• Dynamic Stretch before workout
  – To increase force, power
  – Facilitating stabilizing muscles
• Static Stretch after workout
  – To increase elasticity, flexibility, mobility especially Gastroc-Soleus

Heel Pad Unloading

Lateral to Medial overlapping strips
Close with heel horseshoe

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Navicular Lift/Tab

Navicular Sling Taping: Low-Dye

Sesamoid Taping

Cuboid Sling Taping: Low-Dye

Foot Orthoses

• Lessen MTP instability treated nonoperatively, using functional taping, shoe modifications, and injections. Pack et al 10

Variable direction of over-hang strip for Cuboid or Navicular bias

Variable direction of over-hang strip for Cuboid or Navicular bias

Variable direction of over-hang strip for Cuboid or Navicular bias

Foot Orthoses

• May control LE coupling
• Alters kinetics and muscular activation
• Reduces injuries in runners
• Reduces impact forces and relative velocity of foot and ankle joints
• Total contact orthoses are more effective?

• Subtalar Neutral is a Myth
• Static position is not related to dynamic function
• Does not affect kinematics significantly

Nigg et al 95, Hirschmüller A et al 11, Mundermann A et al 03, Baur et al 11, MacLean et al 10, Cornwall and McPoil et al 99

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Which type of shoe?

**Motion control shoes**
- ↓ force at the foot Cheung & Ng 08
- Delayed fatigue to VMO Cheung & Ng 09
- Delayed fatigue to tib and peroneus long Cheung & Ng 10

**Neutral or cushion shoes**
- Decrease midsole hardness
- ↓ vertical loading rates
- ↓ peak pressures
- ↓ impact shock

Butler et al 06, 07, Cloze et al 03, De Vito et al 05, Milani et al 06, Wagenknecht 08

NO DATA DEMONSTRATES THAT MOTION CONTROL SHOES DECREASE INJURY

**Functional Exercises**

**Impact Phase**
- Adequate ankle dorsiflexion
- Eccentric training for specific ankle/foot muscles
- Single limb balance
- Hopping and recovery
- Drop jumps
- Step downs

**Propulsion Phase**
- Foot Lunge series
- Hopping
- Proximal Stability
- Single limb balance
- Hopping and recovery

**Foot Lunge with Hip ER Stabilization**

**Foot Lunges**
- Retro Heel Raise
- Forward Heel Raise

**Functional Exercises**

**Step Down**

**Patient Education/Prevention**

**Coaching/Running Technique**
- Treadmill running vs over-ground is associated with a lower magnitude of maximum plantar pressure and a lower maximum plantar force at the plantar areas Hong et al 12
- Reduce weekly mileage and carefully progress, especially with prior injury Fields et al 10, Macera 89
- The 10% increase in mileage per week rule is false Buist et al 08
- Reduced overuse running injuries with lower impact forces and a moderately rapid rate of pronation Hreljac et al 00

**Pose vs Chi**
- Forefoot vs Hindfoot Strike

**Towel Flex/Extend**

**Foot fists**

**Knee Press**

**Sitting Soleus**

**Step Down**

**Wall Nod**

**Functional Exercises**

**Inward Pivots/Supination/Hip IR**
- Right foot Involved - Move Left foot

**Outward Pivots/Pronation/Hip ER**
- Left foot Involved - Move Right

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Thank You!

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