Overuse Injuries in Endurance Athletes

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Learning Objectives

• 1. Describe etiology of common injuries of endurance athletes.
• 2. Use a pathoanatomic approach in the diagnosis and treatment of injuries in the endurance athlete.
• 3. Use the best available evidence to guide treatment decisions for injuries in the endurance athlete.

Disclosure

• I have no commercial, financial or research relationships that affect my ability to provide a fair and balanced presentation for this CME activity

Overuse

• Main injury type in endurance athletes is overuse!!
### Overuse Injuries - Triathletes

- 95 competitors (75 men, 20 women) in the 1986 Hawaii Ironman Triathlon
- At least 91% sustained at least one soft tissue, overuse injury during the previous year's training


### Overuse Injuries - Bicyclists

- 294 male, 224 female recreational cyclists responded to mail in questionnaire
- Overall, 85% of the cyclists reported one or more overuse injury, with 36% requiring medical treatment.
- Most common sites: Neck, knee, back
- Female cyclists 1.5 – 2.0 times more likely to be injured


### Overuse Injuries - Running

- Marathon Runners
- Yearly incidence rate of injury about 90% [Satterthwaite]
- Risk of injury increases over 40mpw RR 2.88
- Knee injuries (PFPS) most common


### Overuse Injuries – Summary

- Common in all endurance athletes at all levels of competition.
Overuse Injuries

- Common injuries:
  - Tendinopathies
  - Patellofemoral Pain Syndrome
  - IT Band Syndrome
  - Stress Injury/Fracture

Intrinsic Factors

- Malalignment
- Leg length discrepancy
- Muscle weakness
- Inflexibility
- Body size
- Body composition

Extrinsic Factors

- Training Errors
- Surfaces
- Shoes
- Equipment
- Environmental Conditions
- Outside Stressors
- Inadequate Nutrition

**Tendinopathy**

- Tendons connect muscle to bone – allow transmission of force from muscle to bone
- Overuse tendon injuries account for 30% of all running related injuries [James]

**Etiology unclear**
- Many causes theorized:
  - Ischemia/reperfusion leading to free radicals [Astrom]
  - Hypoxia alone may lead to degeneration [Birch]
  - Stress activated proteins within the tendon [Yuan]

**Increased mucoid ground substance**
- Increase in myofibroblastic cells
- Discontinuity of collagen fibers
- Abrupt discontinuity of vascularity with myofibroblastic proliferation adjacent to abnormal area
- Absence of inflammatory cells

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[Astrom (Thesis) University of Lund 1997]
Tendinopathy

- Common sites of tendinosis in endurance athletes:
  - Patellar tendon
  - Achilles tendon
  - Medial tibia
  - IT Band
  - Hamstring

Treatments for Tendinopathy - Evidence

- Eccentric muscle training
- Topical glyceryl nitrate
- ESWT
- Steroid injection
- Other injectable agents

Eccentric loading exercises

- Curwin and Stanish in 1984 first showed effectiveness of eccentric load in Achilles tendinopathy with 6 week program. (no pain)
- Alfredson then adapted this program to 12 weeks (pain to tolerance)
- Shalibi showed immediate change on MR to Achilles with eccentric exercises

Eccentric exercises for tendinopathy

- Systematic review of 9 clinical trials:
- The effects of eccentric exercise training in patients with chronic Achilles tendinopathy on pain are promising [Kingma] but quality evidence not sufficient
- However, Woodley, et al. in a systematic review of 20 trials found that there was not sufficient evidence to recommend EE

Why do eccentric exercises fail?

- (1) Ongoing overload (i.e. players in season, but also those who overload in ADLs)
- (2) Pathological changes so severe that reversal is not possible with first line treatment.
  ✓ (a) partial rupture – unrepaired
  ✓ (b) calcific changes
  ✓ (c) neovascularisation

Eccentric Exercises - Summary

- Success:
  - Right injury – no partial tear
  - Right patient – off season/low load
  - Certain tendons respond better – achilles, patella
  - ?? Need inflammatory mediator before eccentric activities (under study)

Topical glyceryl nitrate

- NO is important to healing
- Paoloni, et al. looked at application of patch daily x 6 months vs. placebo
- Decreased pain at 12 and 24 weeks with improved outcomes at 6 months
- Studies also positive in lateral epicondylitis and supraspinatous tendinosis [Murrell]

Nitrates

• Kane, et al. found that there was no benefit when using NO patches for achille’s tendinopathy
• Overall, the evidence is contradictory, but they may be helpful in some athletes


ESWT

• Shock-wave therapy, which is thought to function on the tenocytes to stimulate repair, might be effective in a carefully selected group of patients [Rompe]
• In animal model may induce tissue regeneration [Wang]
• Other studies, however, have reported no significant effect.[Speed][D’Vaz]


Other Injection Therapies

• Sclerosant injections have been shown to give at least short term benefit [Alfredson]
• May provide a rational basis for targeting neovascularization in painful tendinopathy, which might be triggered initially by hypoxia and regulated by levels of endostatin and vascular endothelial growth factor.[Pufe]


Other Injection Therapies

• Systematic review of four injection therapies (PrT, polidocanol, whole blood and platelet rich plasma) for refractory lateral epicondylosis
• Eight studies (five prospective case series, three controlled trials) included
• There is strong pilot-level evidence supporting the use of prolotherapy, polidocanol, autologous whole blood and platelet-rich plasma injections in the treatment of LE.

Cortisone Injections

- Used for decades
- Very few RCTs
- Give short-term pain relief
- Weaken the tendon
- Anti-inflammatory but may not be mechanism of action (symptom relief)
- Relieve impingement
- Associated with rupture

Tendinopathy - Summary

- Currently more evidence in support of eccentric exercises than the other interventions
- Low cost and low risk makes these exercises ideal first-line therapy.
- Alternative treatment should be considered in patients who are unable or unwilling to perform or have failed treatment with these exercises.
- ESWT, injections of sclerosing agents, and topical glyceryl nitrate application show promise in early studies without known complications to date, but additional study is needed.

Does surgery work for tendinopathy?

- Previous paradigm of rest, NSAID tablet, cortisone injection and then surgery is no longer valid
- Surgery helpful for shoulder tendinopathy, adductor tendinopathy and probably tennis elbow, plantar fasciitis.
- Seems to be minimally helpful for patellar tendinopathy and insertional Achilles tendinopathy
- No agreement on surgical technique

Patellofemoral Pain Syndrome
Patellofemoral Pain Syndrome

- Loosely defined as retro or peripatellar pain secondary to physical and biochemical changes to the patellofemoral joint
- Patella moves in multiple directions (up/down, tilts, rotates) causing various points of contact between patella and femur
- Multifactorial in nature

Etiology of PFPS

- Q angle often increased
- Normal:
  - Male <15-20°;
  - Female <20-25°
- The value of this measurement for predicting PFS has been questioned

Etiology of PFPS

- Overload and overuse
- Pes planus: “miserable malalignment” syndrome
- Pes cavus: high arched foot causes decreased cushioning with more stress on the patellofemoral mechanism

Etiology of PFPS

- One study found similar Q angles in those with and without PFS. Another found similar Q angles in affected and non-affected legs
- Similar results have been seen in studies regarding sulcus and congruence angles of the PF articulation
History: Clues to Diagnosis

- Anterior knee pain activity related
- Pain worsens with stairs and hills
- Pain worsens with prolonged knee flexion especially with sitting (“theater sign”)
- Giving way or buckling of knee because of quad reflex inhibition secondary to pain
- May have popping or snapping

Examination Signs

- Abnormal patellar tracking with extension
- Positive patellar grind and/or inhibition testing
- May have small effusion
- VMO atrophy or weakness
- Various muscle group tightness

Imaging

- In general needed to rule out other possible diagnoses, not needed to confirm PFS
- Standard views would include a standing AP, lateral in 20 degrees of flexion, tunnel view and a sunrise or merchants view
## Hip and PFPS

- Prospective cohort study of 35 runners with PFPS followed in a 6 week treatment program
- Improvements in hip flexion strength combined with increased iliotibial band and iliopsoas flexibility were associated with excellent results in patients with patellofemoral pain syndrome. [Tyler]


## Treatment of PFS

- PRICEMM
- Quad strengthening (VMO) and PT
- Hip abductor/external rotator strength
- Knee sleeves, PF braces and taping
- Footwear and arch supports
- Surgery – only after a prolonged aggressive rehabilitation process

## Hip and PFPS

- Systematic review of 5 cross sectional studies
- Females with patellofemoral pain syndrome demonstrate a decrease in abduction, external rotation and extension strength of the affected side compared with healthy controls. [Prins]


## PFPS - Summary

- Common problem
- Combination of anatomy and muscular imbalance
- Treatment focuses on quad strength and hip girdle strength
Iliotibial Band Syndrome

- Very common cause of lateral knee pain in peds especially runners
- Due to recurrent friction of the iliotibial band across the lateral femoral epicondyle
- Acts to abduct the thigh (decelerate or control adduction) and anterolateral stabilizer of the knee

Hip and PFPS/ITBS

- Large and growing body of literature suggests that weakness of hip-stabilizing muscles leads to atypical lower extremity mechanics and increased forces within the lower extremity while running. [Ferber]

ITBS: Why?

- ITB is free from bony attachment from superior portion of lateral femoral epicondyle to lateral tibia (Gerdy’s tubercle)
- ITB slides anteriorly in knee extension and posteriorly in knee flexion - tense in both positions
- Multiple biomechanical influences can increase friction and inflammation

Hip and PFPS/ITBS

- There is a strong association between hip abductor, adductor, and flexor muscle group strength imbalance and lower extremity overuse injuries in runners. [Niemuth]
- The addition of strengthening exercises to specifically identified weak hip muscles may offer better treatment results in patients with running injuries.


ITBS: History and Physical

• Lateral knee sharp pain or burning, initially with activity then persistent
• Localized lateral knee tenderness, occasionally pain along the course of the iliotibial band
• Assess strength and flexibility of other muscle groups

ITBS - Summary

• Common problem
• Combination of anatomy and muscular imbalance
• Treatment focuses on quad strength and hip girdle strength

ITBS: Treatment

• Acute phase: ice and phonophoresis, activity modification, NSAIDs. If grossly visible swelling persists for longer than 3 days corticosteroid injection is warranted
• Subacute phase: stretching and strengthening, gradual resumption of regular activity

Stress Injury

• Common in endurance athletes
• Spectrum of diseases
• In tibia ranges from:
  • Shin splints
  • MTSS
  • Stress Rxn
  • Stress Fx
  • FX
Stress Fracture

- Microfracture of bone that results from repetitive physical loading
- Localized pain and tenderness at fracture site
- Recent change in training
- Worse with impact, increases with exercise
- Initial radiographs often negative
- May need further imaging

Physical Exam

- Local bone tenderness
- ++ Metatarsal, tarsal navicular, tibia, forearm
- +/- Pelvis, lumbar spine, rib, proximal humerus
- ? Femoral neck, femoral shaft
- Other helpful tests
  - Lumbar spine- pain with extension, single leg extension
  - Femoral neck- internal rotation, log roll
  - Tibia, femur- hop test
  - Long bones- fulcrum test

Pain Continuum

1. Mild Stress Reaction
   - Local pain toward end of activity
2. Moderate Stress Reaction
   - Local pain earlier during activity
3. Severe Stress Reaction
   - Significant pain throughout activity, persists
4. Stress Fracture
   - Pain with daily activities and rest

Risk Factors for Stress Fx

- Repeated loading of the bone
- Menstrual disturbances, caloric restriction, lower bone density, muscle weakness and leg length differences [Bennell]
- Previous stress fractures, lower bone mass, and possibly menstrual irregularity [Kelsey]
- Female gender and low aerobic fitness measured by run times are risk factors [Jones]
Stress Fx – High Risk

- High Risk
- Femoral neck
- Tibia anterior cortex
- Medial malleolus
- Talus
- Navicular
- 5th metatarsal
- Great toe sesamoids
- Spine- bilateral pars (spondy)

Stress Fx - CT

- Very good for imaging bones
- One particularly useful application of CT is for the evaluation of stress injuries of the spine
- Limited in demonstrating the activity of the lesion
- May need bone scan

Imaging Stress Fracture

- Start with high resolution radiographs
- Radiographic findings can sometimes lag behind the clinical presentation
- May need advanced imaging
  - CT
  - MR
  - Bone Scan

Stress Fx – Bone Scan

- Scintigraphy is sensitive for diagnosing early stress remodeling and stress fractures
- Although nuclear medicine scintigraphy is quite sensitive for the evaluation of bone turnover and therefore can detect very early development of stress reactions or stress fractures, this method is not specific for fractures
- Nuclear medicine examinations must be interpreted with close correlation of conventional radiographs as well as the patient’s clinical history
### Stress Fx - MR

- MRI can provide detailed information regarding the presence of a stress fracture or stress reaction, especially in cases in which the radiographic findings are inconclusive.
- MRI provides a comprehensive evaluation of the area in question, providing morphologic as well as functional information.
- MRI as a routine diagnostic imaging modality was superior to radionuclide bone scan [Shin].


### Stress Fx - Treatment

- Stress fractures are best managed by prevention.
- Training errors, such as an excessive increase in intensity, are the most frequent culprit and should be corrected. [Boden]
- Athletes, coaches, military personnel, and parents should be educated about the deleterious effects of overtraining and the importance of periodic rest days.
- In addition, female athletes and their coaches need to be alerted to the adverse effects of eating disorders and hormonal abnormalities.

### Stress Fx - Management

- Stress fracture management should take into consideration the injury site (low versus high risk), the grade (extent of microdamage accumulation), and the individual's competitive situation.
- Low-risk stress fractures usually respond well to nonoperative management, and treatment is largely guided by the patient's symptoms.
- High-risk stress fractures should be treated more aggressively with absolute rest or surgical fixation, with the goal of fracture healing and minimizing risk of complete fracture or refracture.

### Stress Fx - RTP

- Graduated Load Program
- Stage 0  pre-entry  walking aids
- Stage 1  walk jog 2d on 1d off
- Stage 2  jog every other
- Stage 3  4 jog loads per week
- Stage 4  5 running loads per week
- Stage 5  sport activity
- Pain guides the level

### Summary

- Overuse injuries are common
- Prevention is the best treatment

### Stress Fx – RTP

- May use pneumatic braces, sleeves
- Ultrasound
- Meds?
- Cyclic or cross training for athlete and body part
- Swimming, cycling, weight training, stretching
- 6 to 8 week recovery is usual