


**Chronic Exertional Compartment Syndrome:  
Trauma 101 Lower Extremity Symposium**

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**I HAVE NO DISCLOSURES or COI**



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**Outline**

- Background
- Anatomy & Pathophysiology
- Evaluation (DDx)
- Treatment Options
- Outcomes & Complications
- Summary



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## Background

- Dr. Edward Wilson (1912)
    - South pole expedition
  - Mavor JBSJ Br (1956)
    - 1<sup>st</sup> surgical account
    - "Anterior tibial syndrome"
  - 27% of exercise induced leg pain
    - 2<sup>nd</sup> to MTSS
  - 60-80% bilateral symptoms
  - Anterior & lateral compartment
    - 95% of cases (?)
- ... Also described in thigh & forearm



AJSM 2014




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## Anatomy

### Lower leg (4 compartments)

- Muscles, 1 nerve, some blood vessels

#### Anterior

- TA, EHL, tertius
- DP n.; Ant tib a.

#### Lateral

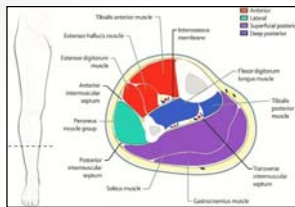
- Longus, brevis
- SP n.

#### Superficial posterior

- Gastroc, soleus
- Sural n.

#### Deep posterior

- FHL, FDL, PT
- PT n.; PT a.



Lancet 2015




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## Pathophysiology

### NORMAL

- Normal muscle physiology can accommodate 20% increase in volume (w/ activity)
- Muscles receive blood flow when relaxed
  - Dynamic exercise precludes perfusion during contraction
  - i.e. between contractions
  - Increase in relaxation pressure, can impede blood flow (ischemia)
- Fascia
  - Noncompliant
  - Osseous boundaries

Clin Sports Med 2012




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## Pathophysiology

**“Abby”normal**

- Pressure threshold
  - Insufficient flow for metabolic requirements of muscle
  - Ischemic pain; muscle dysfunction (performance)
  - metabolic demands are met, pain resolves (rest)
- Risk factors
  - Fascial defects (auto-release; 40% v 5%)
  - Lower capillary density & number
  - Anabolic steroids (hypertrophy)
  - Myofascial scarring




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## Evaluation


**History**


- Exercise induced pain
  - Well-defined time during exercise
  - Resolution w/ rest
  - Dull/burning compartment
- **Tremendous insight**


**Physical Exam**

- Often normal
  - Re-examine after exercise
  - Tenderness
  - Tension
  - Herniation
  - Detailed neuro exam

"I should stop running until that pain goes away," said no runner ever.







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## Evaluation: Differential Diagnosis

Diagnosis	Features	Studies
Stress fracture	Localized pain	MRI
MTSS	Posteromedial pain; entire tibia	MRI
Nerve entrapment	Isolated neuro symptoms; anatomic	EMG, NCV
PAE syndrome	Cool sensation; paradoxical claudication	Angiogram

... Can be extensive... Be thorough  
 ... It will see you... make sure you see it



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## Evaluation: Diagnostic Testing

- Largely clinical
- Consider:
  - Pressure measurements
  - MRI
  - Near-infrared spectroscopy (NIRs)
- *No consensus*
- *Lets sort thru some literature*



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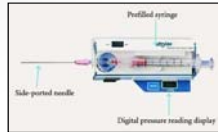
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## Pressure Measurements

- Current "gold" standard
- Needle manometry
  - All four compartments
  - Pre, 1 & 5 minutes post
- Pedowitz *AJSM* 1990
  - $\geq 15$ ,  $\geq 30$ ,  $\geq 20$  mmHg
  - Controls (5.7-12 mmHg)
- Metanalysis: 2012 *Clin J Sport Med*
  - Only values after 1 minute accurate



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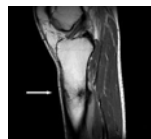
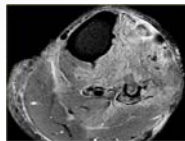
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## MRI

- Expanding Role
- Non-invasive
  - *r/o* other pathology
- *Skeletal Radiology* 2013
  - Post-exercise (T2)
  - Muscle edema
  - Correlate w/  $\uparrow$  pressures
  - 87% sn; 62% sp



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### Near Infrared Spectroscopy (NIRs)

- Measures hemoglobin saturation of tissues
  - Optical technique
  - Measures absorption of light in blood
  - Levels of oxygenated v deoxygenated blood
  - Sn when ratio is elevate post-exercise

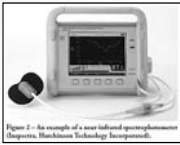


Figure 2 - An example of a non-invasive spectrophotometer (Devison, Noninvasive Technology Incorporated).

Curr Sports Meds Rep 2003




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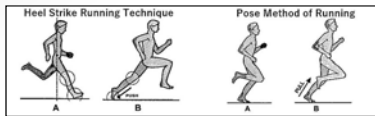
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### Treatment: Nonoperative

- Activity modification (cessation or substitute)
  - Good luck!
  - Rest, ice, NSAIDs, massage, **stretching**, ultrasound, shoe modification (40%)
- Gait modification
  - Forefoot running
  - Diminish ICP & eccentric ant activity
  - Small military study 78 mmHg to 32 mmHg



Clin Sports Med 2014




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### Treatment: Surgical

- Compartment release
  - Remains gold standard
- Many techniques ?
  - One incision, two incision, or endoscopic
  - Slimmon AJSM 2002: Two is better
  - KNOW risks/benefits
- Involved vs all four ?
  - Schepesis AJSM 1993: just involved
- Staged vs bilateral ?
  - Raikin Foot Ankle Int 2005:
  - Faster return w b/l




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### Outcomes

- Civilian Cohorts
  - 90-96% good - excellent results
- Posterior Compartment less reliable
  - 25-50%
  - Thicker fascia ?
  - Post tib separate compartment ?
  - Symptoms multifactorial ?
- Military data less reliable
  - 78% good results
  - 28% inability to return to full duty

Clin Sports Med 2000



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### Complications: TAKE HEED

- Overall 11-16%
  - Persistent drainage, infection, nerve injury, vascular injury, DVT, CRPS, hematoma, scar hypersensitivity
- Recurrence
  - 2-17%
  - Minimally invasive (historic)
  - Incomplete release, excessive scarring, wrong diagnosis
- Waterman et al JBJS 2013
  - 754 fasciotomies
  - 45% w/ recurrence
  - 6% revision rate
  - 14% w/ complete resolution

JBJS 2013



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### Summary

- Clinical diagnosis first and foremost
  - Get the diagnosis correct
  - r/o other causes
- Consider forefoot running
- Build a relationship (complications & recurrence)
  - Bring patient back
  - Don't rush into surgery
- Release only involved compartment
- Posterior compartment less reliable



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Thank you!  
Questions / Comments



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