Recognition, Rehabilitation and Prevention of Stress Fracture in Runners

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Stress Fracture in Runners

- Location
- Recognition
- Risk Factors
- Management
- Prevention
Wolff’s Law

“Bone is a living structure and adapts itself to its surroundings and demands placed on it in accordance to mathematical laws”

Julius Wolff, 1892
Bone remodelling

- Resorption
- Reversal
- Resting
- Formation
Aetiology

Load

Accelerated Remodelling

Weakening & crack

Continued over-load

Propagation of micro-cracks

Partial or Complete Fracture
Staging Acute Bone Stress

- **Stress Reaction**
  - Marrow Oedema
  - Periostitis

- **Partial Stress Fracture**
  - Partial disruption of the cortex

- **Complete Stress Fracture**
  - Full thickness cortical breach
Common Locations

High Risk
- Femoral Neck
- Tibia
- Navicula
- Talar Neck
- Base 5th MT

Low Risk
- Sacrum
- Lateral Malleolus
- Calcaneus
- MT 1 - 4
History

- Gradual onset localised pain
- 2 - 6 wks after increase in training load
- Pain at specific stage of session
- Progressively earlier in training
- Rest Pain
- Night Pain
- Crescendo pain
- None of the above!
Examination

- Point Tenderness
- Bony +/- Soft Tissue Swelling
- Impact pain
  - Run on spot
  - Jump
  - Hop
Investigations

Xray

Bone Scan

CT

MRI

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Investigation Algorithm
MRI +/- CT
Sacral Stress Fracture MRI
Inferior Cortex Femoral Neck
A process, not an event

Bone Stress Injury

Workload & Fatigue

Muscle Balance

Footwear

Technique

Nutrition

Gender

Previous Injury

Surface

Age & Growth

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Energy, Menstruation and Bone Health

- Energy deficiency
  ‘Female Athlete Triad’

- Amenhorrea
  Sign of insufficient energy for bone formation

- Energy deficiency reduces bone formation within 5 days
Vitamin D and Bone health

• Calcium regulation
  Increases intestinal absorption

• Low Vitamin D – results in increased bone catabolism (to maintain serum Calcium)
Workload

• Too Little
  Lower bone strength
  Unaccustomed use injury

• Too Much
  Overuse injury
Management
High Risk

• Aggressive Management
• Complete Fracture Surgery
• Incomplete NWB immobilisation Surgery?
Pneumatic Boots and Braces
Low Risk

- Conservative
  - Load modification
  - Manage risk factors
- Symptomatic
  - Load modification
  - Manage risk factors
- Asymptomatic
  - Monitoring
Stress Fracture Treatment Options

- Nutrition and Energy Deficit
- Vitamin D Supplementation
- LIPUS (Exogen)
- Medication
  - Nasal Calcitonin
  - Bisphosphonates
    - Stops resorption
    - Old bone stays around
Rehabilitation

- Follow Prevention Principles
- Cross-Training
- Milestones
  - Functional/Symptom & Time based
    - (Kaeding 2005, Ivancovic 2006)
- Team Approach
  - Tackle risk factors
Stress Fracture Prevention
Previous bone stress injury

- Prevention plan in place
- Low threshold for:
  - Reporting
  - Investigating
- Bone Density
  - DEXA
  - pQCT
Nutrition & Supplementation

- Adequate Energy Intake
- Vitamin D and Calcium Supplementation

800 U Vit D and 2g Calcium daily

20% reduction in stress fractures in army recruits (Lappe, 2008)
Allow Time for Bone Adaptation

• 7 - 4 - 2
  In seven days
  4 running/high-impact sessions
  No more than 2 days in a row
Allow Time for Bone Adaptation

- Progress only one parameter at a time
  - Volume
  - Intensity
  - Surface
Surfaces

- **Hardness**
- 1. Grass
- 2. Dirt Road
- 3. Track
- 4. Tarmac & Concrete
- **Hills & Cambers**
Muscle Imbalance

- **Flexibility**
  
  Stiff foot and ankle = more stress to tibia, femur, sacrum...

- **Strength, Endurance & Control**
  
  Smaller weaker calves = increased stress fracture risk

“muscle has the ability to absorb 100 times the shock than a bone of the same length” (Popp 09)
Eccentric Soleus Strength
Bent Knee Calf Raise
Eccentric Soleus Strength
Reclining Bent Knee Calf Raise
Footwear

• Appropriate model for foot type & mechanics
• Rotate at least two pairs
• Orthotics
• Socks
Technique & Sub-Optimal Loading

• 1st MT designed to resist bending force
• Lateralised foot loading (low gear)
  MT 2 - 4 stress
• Unchanged technical issues
  Recurrence?
Technique

- GRF
- Foot Mechanics
Stimulating Bone Growth

- High Frequency, Intermittent, Low Intensity, Multidirectional
- 5 - 10 Hz optimal osteogenesis
  - Vibration Plate
- 2 Hz
  - Skipping
  - Jumping
- 40 - 60 Contacts
- Rest Period
Sample Programme

• 2 sessions/day
  
  1 skipping
  
  1 multi-directional jump circuit over low hurdles

• 40 contacts/session

• 3 - 5 sessions/week

• Factor in other impact training
Summary

- Determine Risk of Fracture Type
- Multidisciplinary Rehab and Prevention Plan
- Correction of energy deficit
- Check Vitamin D
- Creative, appropriate running and conditioning programs
- Monitoring
ATLAS OF
Living and
Surface Anatomy
for Sports Medicine

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