Outline and Declaration

- Clinical Diagnosis
- Imaging
- Management - Proven innovations or false hopes and hype?
- Questions

- No Conflict of interest to declare

Diagnosis - History

- Diagnosis is Clinical > 85% of cases
  - History
    - Usually Gradual onset
    - Associated with activity
    - Increase or change in load (ERG, Volume, Side)
    - Pain on Cough / deep breathing
    - More severe - Pain with normal movements, Sleep, Rolling over, Rotation, Push / Pull
    - NB - Risk Factors - Menstrual Hx, Energy Intake (REDS), Previous Stress #s, Biomechanics, Adaptive athletes (Strapping)

Diagnosis - Exam

- Exam
  - Splinting
    - Decreased inspiratory expansion or pain.
    - Decreased T Spine lat flexion / rotation
  - Localised tenderness
  - Rebound compression pain (Spring Test)
  - ? Swelling and oedema
  - Pain
    - Resisted rotation / flexion
    - Simulated stroke

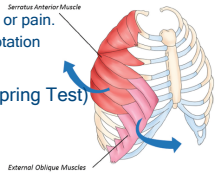


Image in Roston AT, Wilkinson M, Forster B. Br J Sports Med. 2017; 51: 1093 - 1097

Diagnosis - Investigations

- **Most Cases do not require imaging**

BUT ..Indications for Imaging may include;

- Unusual onset (acute) / presentation
- Associated trauma
- Unusual Location or nature
- Non response to normal treatment
- Diagnostic Dilemma (Unclear)
- Competition / Training timing and management planning

Diagnosis - Investigations

- Xray
- Bone Scan
- CT
- MRI
- U/S
- PET CT/MRI
- Supplementary - For Risk factors / Non Rib Pathology

Investigations - X-Ray

- Low initial Sensitivity
  - 10% (Up to 70% later)
- Subtle signs
- Non Stress # pathology
- Non Union etc
- Radiation Dose 0.05 - 0.24 mSv

Image from www.musculoskeletalkey.com/stress-fractures-of-the-ribs-and-girdle

Investigations - CT

- Less frequent now
- X-Ray -ve then CT can show subtle early signs and trabeculae.
- Union vs Non - union (periosteal reaction)
- High Radiation - 4.0 - 18 mSv

Investigations - Bone Scan

- Early Changes (24-36 hrs post #)
- 2 weeks before radiographic changes)
- Sensitivity 72-95%
- Poor specificity (45-70%)
- False positives
- Radiation dose 6.3 mSv

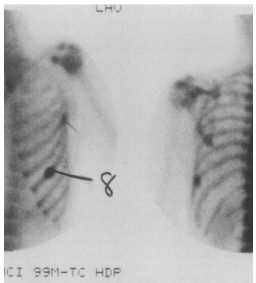
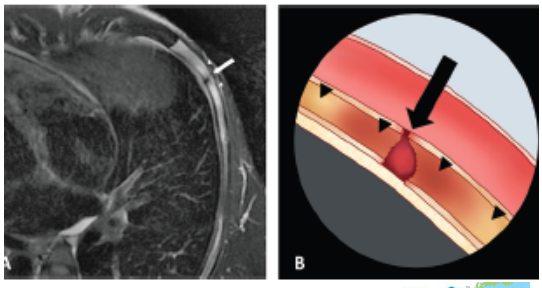


Image c/o Galilee – Belfer A, Guskiewicz K. Stress Fracture of the 8th Rib in a Collegiate Rower: A Case Report, JATA 2000; 35(4) 445-449

Investigations - MRI

- Highest Sensitivity and specificity – "Gold Standard"
- Earliest signs – Bone Marrow Oedema may be present before clinical Sx (Kountouris et al)
- Fracture visualisation and soft tissues defined
- Grading system 1 – 4 (Frederickson et al)
  - Severity
  - Predict recovery and Return to Sport
  - (in lower limbs) Nil in Rib stress injuries
- No Radiation
- Changes persist post recovery
- Expensive
- Availability

Investigations - MRI



T2 Axial MRI. Cortical Disruption and Bone Marrow Oedema.

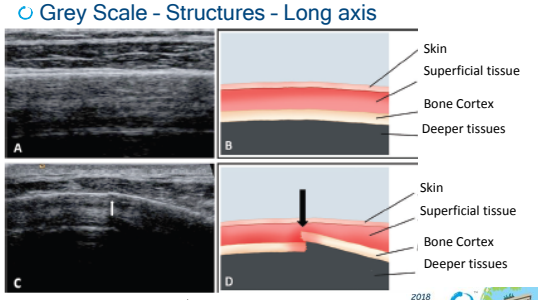
Roston AT, Wilkinson M, Forster B. Br J Sports Med. 2017; 51: 1093 - 1097

Investigations - PET

- Radioactive Tracers – increased metabolic activity.
- Historically PET/CT
- Recent dev of PET/MRI
- Minimal use in stress #s (Oncology, Neuro, F&A)
- Radiation dose higher
- Cost and availability

Investigations - US

- Grey Scale - Structures - Long axis

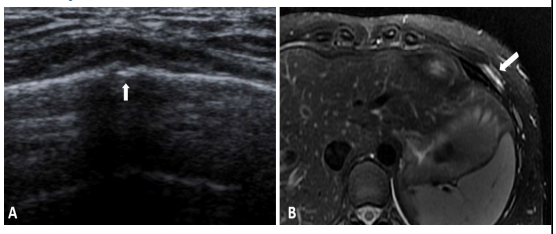


31 Yr International Male Rower L 6th Rib. (A/B - Normal. C/D Stress #)

Roston AT, Wilkinson M, Forster B. Br J Sports Med. 2017; 51: 1093 - 1097

Investigations - US

- Grey Scale vs MRI

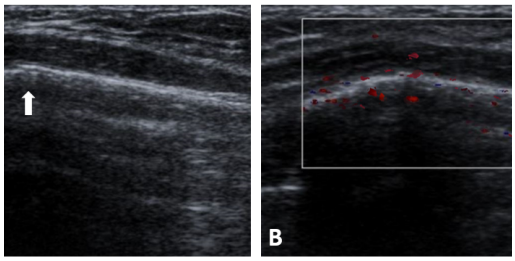


29 Yr Female International Sweep Rower – Antero-lateral L 7th rib

Roston AT, Wilkinson M, Forster B. Br J Sports Med. 2017; 51: 1093 - 1097

Investigations - US

- Grey Scale (Anatomy) plus Colour flow Doppler (Hyperaemia)
- Hyperaemia over site of tenderness - diagnostic



30 yr Male international Rower - L 5th rib (Roston A, et al)

Investigations - US

- Sensitivity 83.3% - 81.9%
- Specificity 66.6% - 75.9%
- Pilot studies – feet and lower limbs. (Papalada A, et al and Banal F, et al)
- NO RCTs in rib stress #s
- UBC pilot series (21 cases un-published) – 95% sensitivity / 85% specificity

© Siemens

Investigations – US - Developments

- Cheaper lighter and more powerful machines
- More portable wireless options – now travel friendly
- Real time combined with guided interventions
- No Radiation
- Apps – Viewed on normal screen and remote radiologist reading

© Clarius

Investigations - US

- Diagnostic clarification and planning esp. in camp / ~~regattas and travel~~
- Athlete Education Real Time
- ~~Monitoring of recovery and healing~~
- Issues
  - Operator dependent
  - Significant steep learning curve
  - Lack of RCTs and data in Rib stress #s
- Further studies required

Investigations - Summary

Table 1 Imaging modalities for detecting stress fractures. The sensitivity and specificity values were obtained from a recent systematic review examining these modalities' accuracy in diagnosing lower extremity stress fractures.[24] Unfortunately, no data specific to the ribs is available

Imaging modality	Advantages	Disadvantages	Sensitivity (%)	Specificity (%)
Radiography	▶ Assessment of adjacent soft tissues (eg, lungs)	▶ Subtle fracture findings are not well visualised. ▶ Ionising radiation risk, but low dose. ▶ Non-portable to field of play.	39–56	94–96
CT	▶ Assessment of surrounding soft tissues ▶ Possible detection when radiograph is negative	▶ Ionising radiation risk ▶ Higher cost ▶ Non-portable	32	98
Bone scintigraphy (bone scan)	▶ Reference standard for diagnosing bone stress injuries ▶ Early fracture detection (compared with radiograph)	▶ Ionising radiation risk ▶ False-positive rate relatively high ▶ Fracture line cannot be visualised ▶ Non-portable	75–92	45–71
MRI	▶ Early detection ▶ Visualisation of fracture line ▶ No ionising radiation ▶ Assessment of bone and surrounding soft tissues ▶ Faster exam time (compared with bone scan)	▶ Higher cost ▶ Non-portable	68–99	92–84
Diagnostic ultrasound	▶ No ionising radiation ▶ Possible early fracture detection ▶ Low cost ▶ Non-invasive ▶ Portable	▶ Few studies for effectiveness ▶ Accuracy is operator dependent	43–85	49–75

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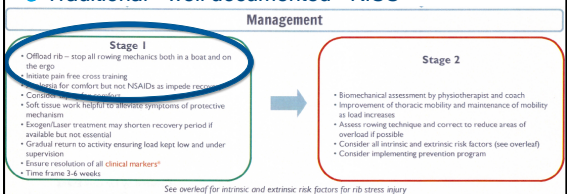
Management

- Traditional - well documented - KISS



Drs Guy Evans and Anne Redgrave – GB Rowing – In BJSM

Management - Adjuvant

- Vit D / Calcium
- Adjuvant modalities - additive
- Minimal research and RCTs esp in Rib stress #s
- Exogen (Bone Growth Stimulators)
  - Research in delayed union and longbone stress #s
  - Anecdotal reports of reduced pain and lost training time
- Biphosphonates IV
  - Shima et al - No conclusive evidence (2002)
  - Reduction in pain and oedema - Ringe et al (2005)
  - Teratogenic
- PTH
  - Research in biphosphonate stress #s and animal models
  - Single sub cut injection - case reports promising
- Calcitonin
  - Promising reduction in pain and time to resolution
  - Increased incidence of malignancy reported - routine use discontinued ? Recalcitrant

Management - Biologics

- PRP
  - Evidence in race horses / dental and delayed union of vertebral #s
  - Pain Modulating factors and IGF / PGs
  - Anecdotal evidence of faster healing and return to training
  - Leucocyte rich vs Leucocyte poor?
  - Poor predictive value on individual response
  - More RCT quality research needed
- Stem Cells/ GH - No Evidence
- Prolo-therapy - No evidence

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Thank You - Questions