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MRI detectable markers for condylar fracture

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Condylar Fractures

- Condylar fractures are the most common fracture suffered by the racehorse.
- They involve the end of the canon bone, at the upper part of the fetlock joint.
- They can often be repaired, but sometimes the injury is so severe it requires the euthanasia of the horse because functional repair is impossible.
- Even following repair, many affected horses remain lame when returned to training, because of the irreversible damage to the joint surface which occurs following fracture.

What is known about risk factors for condylar fracture already?

- Most common site of fracture in UK
  - 45% of catastrophic distal limb fractures (Parkin et al. 2004)
- Risk factors identified
  - Training
    - A lack of fast work
    - First year of training
  - Racing
    - First race as 3 or 4 year old (compared to 2 year old)
  - Race
    - Longer, more runners, amateur jockey races
    - Firmer going (Parkin et al. 2005)

Overall Aim of the Study

- This study was set up to:
  - look at the features of bone shape and internal structure in canon bones from horses that had fractured in a race, and compare them to normal canon bones from racehorses that died for other unrelated reasons.
  - Determine if there were inherent differences, predisposing the bone to fracture, which could be measured in the living horse and used as a marker to 'flag up' any individual horse at being at risk of fracture?

Specific Aims

- Identify significant differences between fractured and non-fractured bones / horses.
  - Geometric, structural and pathological
- Determine if these markers are horse or bone specific.
- Estimate which markers may be useful in predicting fracture.

Where do condylar fractures begin?

- Most develop in a specific area called the lateral parasaggital groove (arrow).
- Therefore this is a good place to look for differences between fracture cases and normal horses.

Where do condylar fractures begin?

- Bone in this site often becomes very dense and hypermineralised (has excessive calcium crystals and not much 'bendy' collagen) as a result of repetitive impact in high speed exercise.

- The researchers asked: Was there a difference between the depth of this dense bone in fracture cases and normal horses?

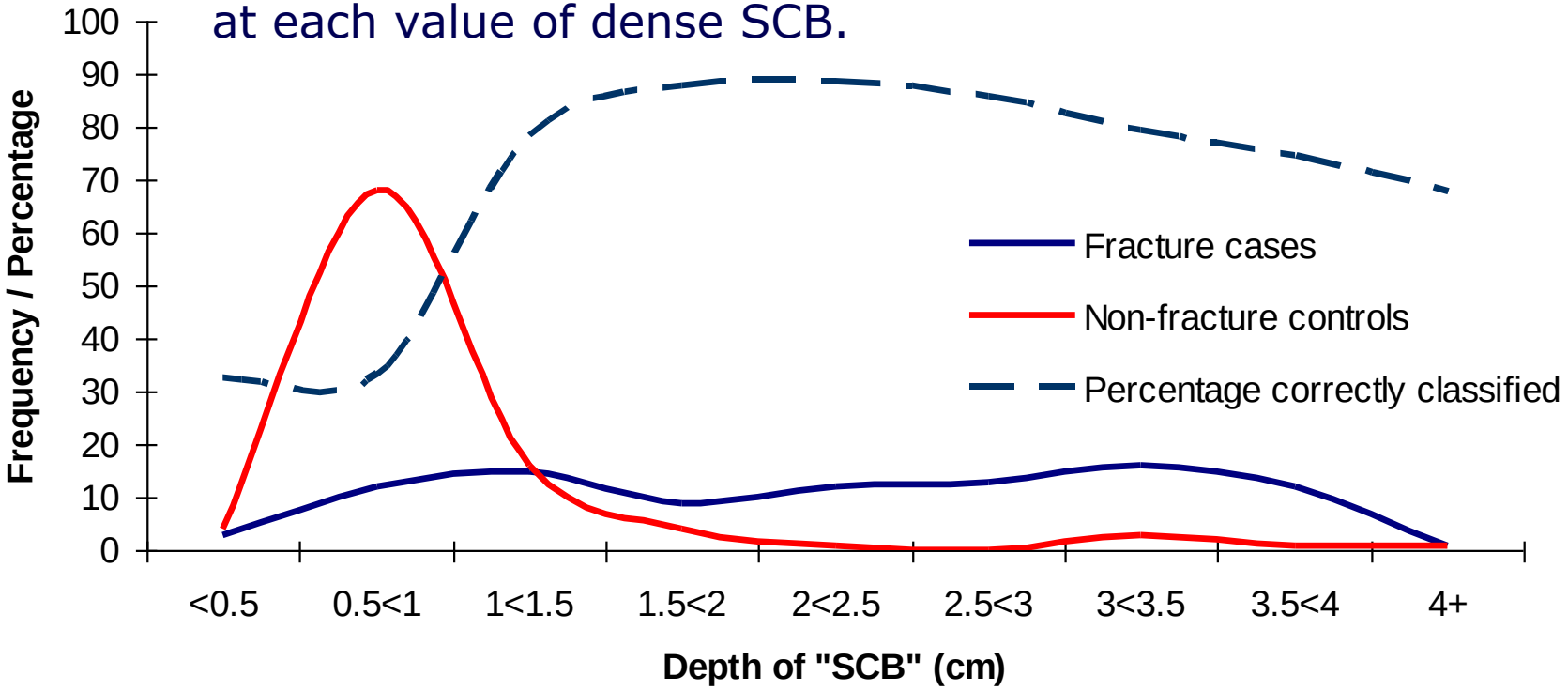
How were the bones assessed?

- The depth of ‘super-dense’ bone was measured using a technique called magnetic resonance imaging (MRI).

- This makes the dense bone ‘jump out’ as very black on an MRI scan, so it can be easily measured (arrows).

What was found?

- There was a big difference in the depth of dense subchondral bone (SCB) between fracture cases and normal horses.
- Fracture cases tended to have more "dense subchondral bone".
- The dotted line shows the percentage of bones correctly classified at each value of dense SCB.



So can we predict which will fracture?

- 90% of horses with dense bone thicker than 1.6 cm at this site were at an increased risk of bone fracture.

- If we use 1.6cm as the "critical" value, above which we would suggest a horse is at risk and below which the horse is not at risk, 83% of the "test positive" cases (i.e. 83% of those that measured above 1.6cm) would sustain a fracture.

So can we predict which will fracture?

- This is a reasonably high positive predictive value and does suggest that this MRI measurement may be a useful indicator of fracture risk.

Conclusions

- Significant differences were seen in several geometric and structural properties between horses / bones with lateral condylar fracture and non-fractured horses / bones.

- Can any of these be used for screening?

  - The precise nature of the dense bony changes need to be clarified by histopathology (microscopic examination of very thin sections of this bone stained to identify different tissues), and this may lead to more accurate diagnostic tests.

Commentary on conclusions

- It is crucial that if screening is going to be implemented it must be quick, cheap and easy.
- Currently this is not the case, but expected technological advances should help overcome some of these logistical issues.
- Importantly these studies have given us an idea of what we should be monitoring when the screening tools do become easier to use.

What can be done to help susceptible horses?

- More work is needed to answer this critical question but potentially:
  - Alter the training regimen to avoid deleterious exercise?
    - Based on epidemiological risk factor studies
  - Re-screen to monitor progress and adjust exercise?

Find out more about fractures in racehorses

- Magnetic resonance imaging-detected adaptation and pathology in the distal condyles of the third metacarpus, associated with lateral condylar fracture in Thoroughbred racehorses

  C. A. Tranquille, T. D. H. Parkin, R. C. Murray

  http://onlinelibrary.wiley.com/doi/10.1111/j.2042-3306.2011.00535.x/abstract

- Musculoskeletal disease and injury, now and in the future.

  Part 1: Fractures and Fatalities

  PD Clegg

  http://onlinelibrary.wiley.com/doi/10.1111/j.2042-3306.2011.00457.x/full

Scientist's summary

- Fractures of the lower end of the cannon bone are the most common reason for horses being subjected to euthanasia during racing. It is crucial that we are better able to predict which horses are most likely to sustain a fracture by identifying pre-fracture changes before catastrophic injury occurs.

- Fractured and non-fractured bones were compared using MRI in order to identify differences that may have been precursors for fracture. One of these markers (the depth of dense bone at the location where fractures most often occur) appears to be a useful tool to discriminate between fractured and non-fractured bones.

- With this information it may be possible to screen horses in training for early changes that are pre-cursors for fracture.