Understanding and preventing bone injury in athletic horses

Equine Limb Injury Prevention Program

Professor Chris Whitton

Summary

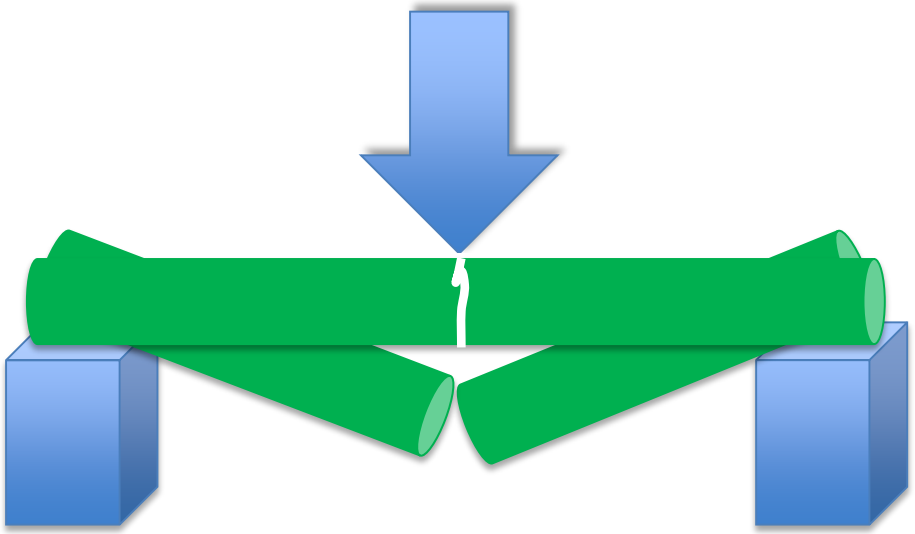
Two key processes in catastrophic injuries

1. The accumulation of damage
   - Bone fatigue
2. The response of bone
   - Bone adaptation
   - Bone repair

Bone fatigue

Cyclic loading

Structural damage



Bone fatigue

Cyclic loading

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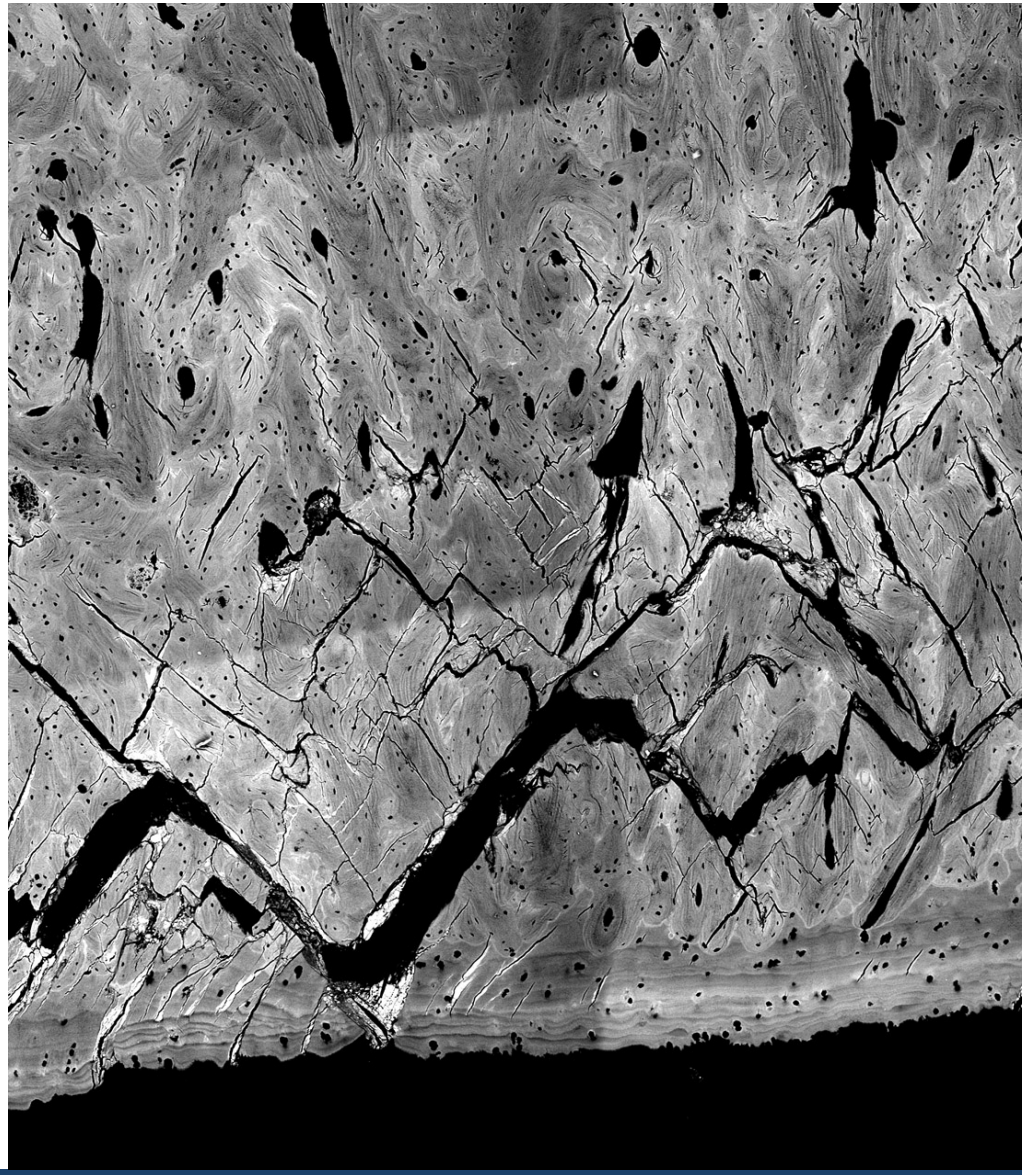
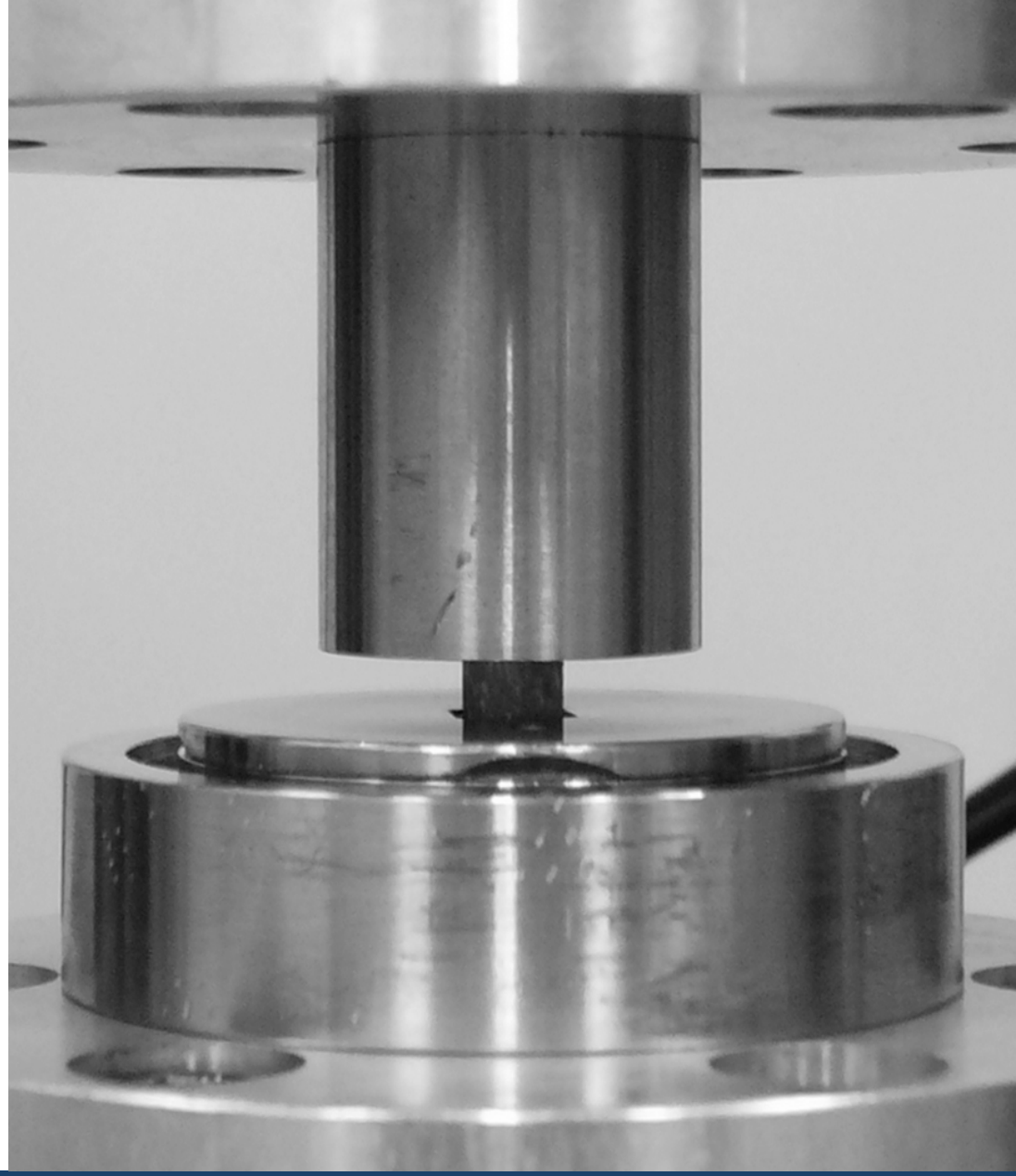


Bone fatigue

Cyclic loading

Structural damage



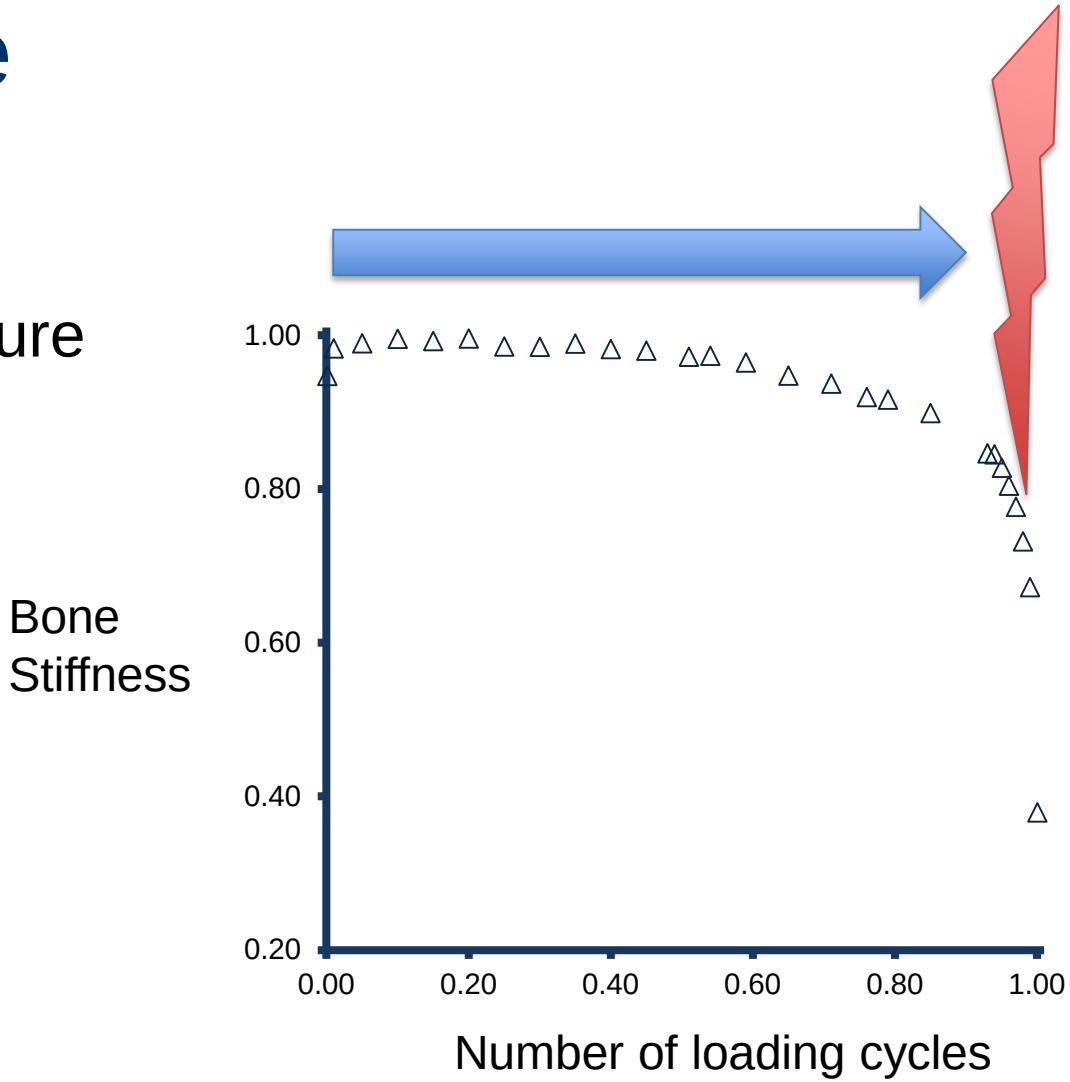
Bone fatigue

Cyclic loading

Structural damage

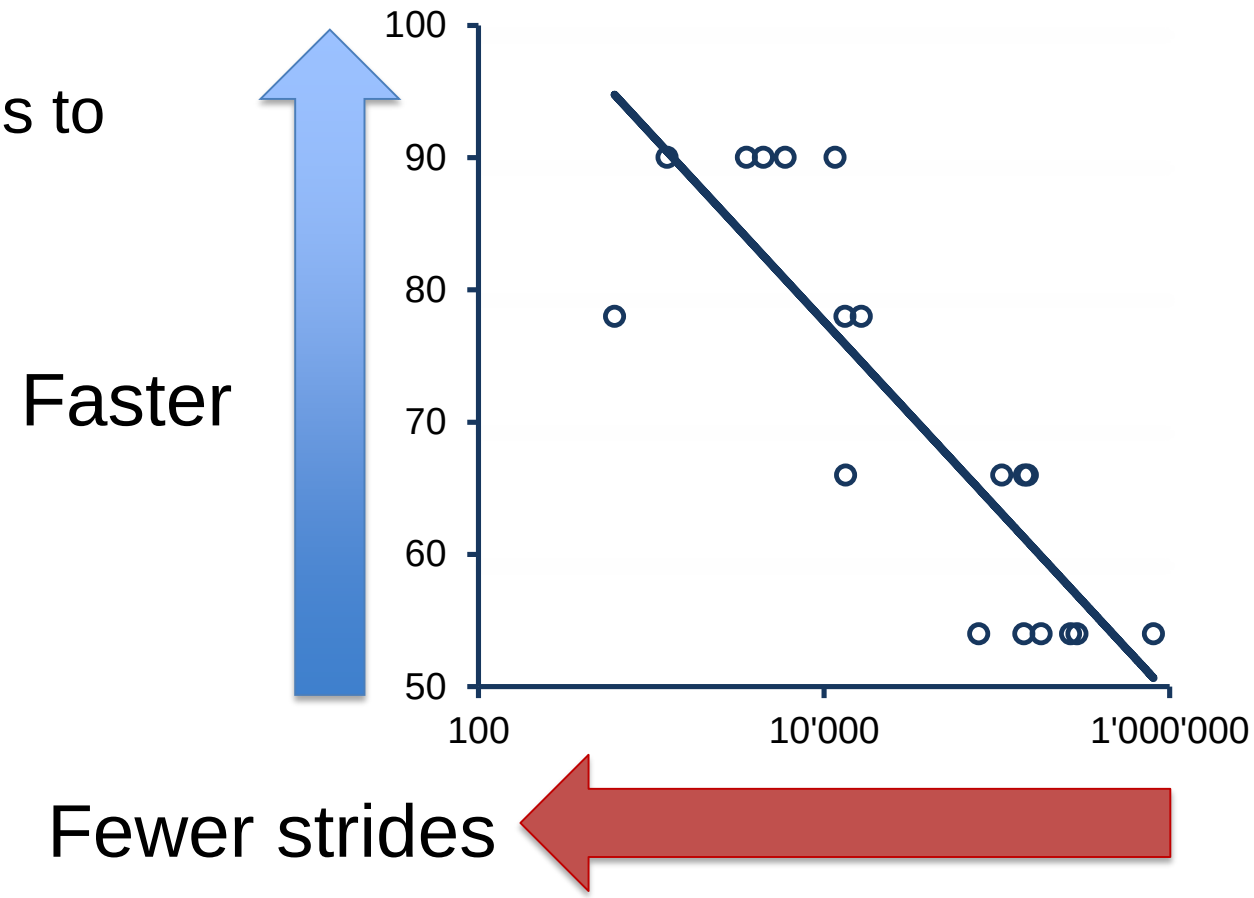
Bone fatigue

- Fatigue life
  - Number of cycles to failure



Bone fatigue

- Fatigue life
  - No. of cycles to failure

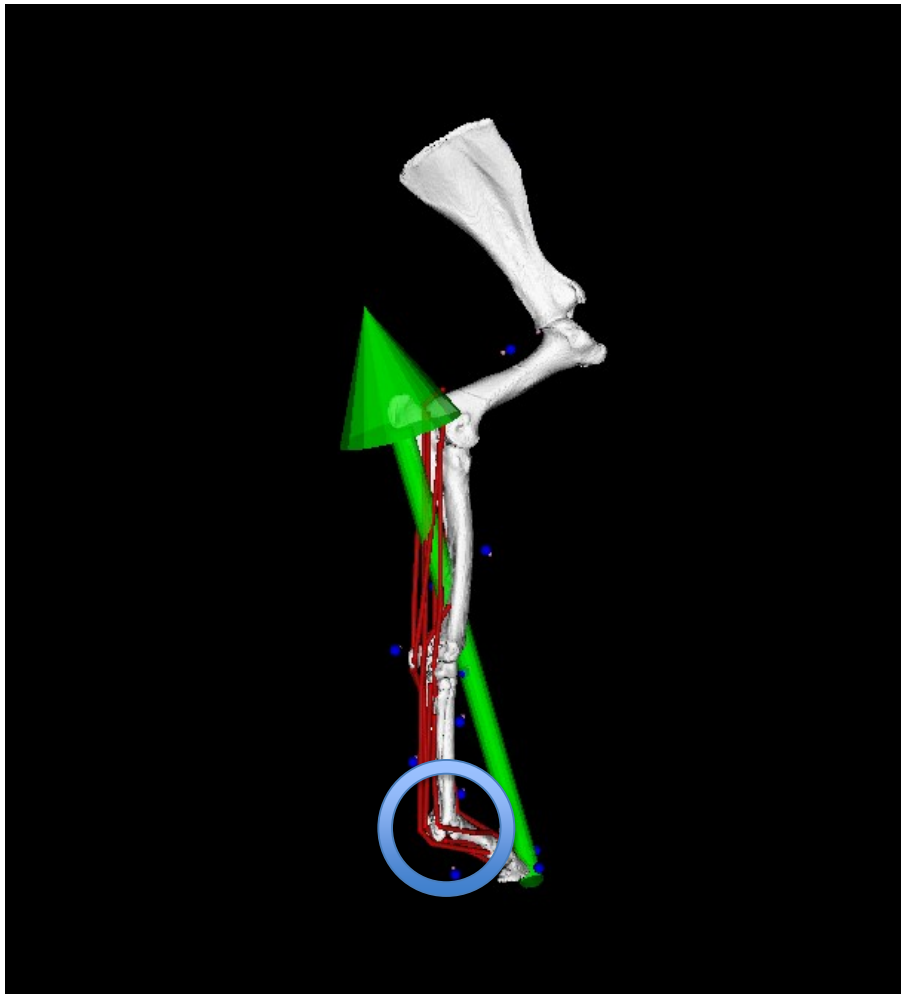


Bone fatigue

- High loads
  - Short fatigue life

Fetlock joint loads

Walk	(4 km/h)	0.8 tonnes
Trot	(13 km/h)	2.3 tonnes
Canter	(27 km/h)	2.6 tonnes
Gallop	(48 km/h)	4.0 tonnes



Bone fatigue

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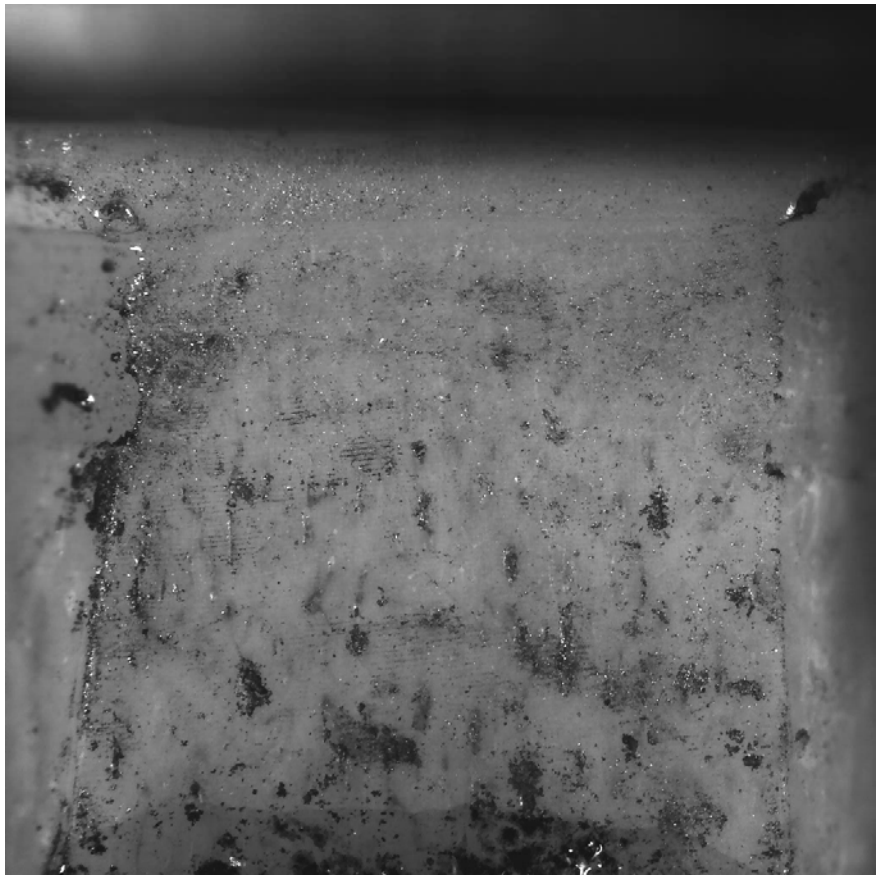
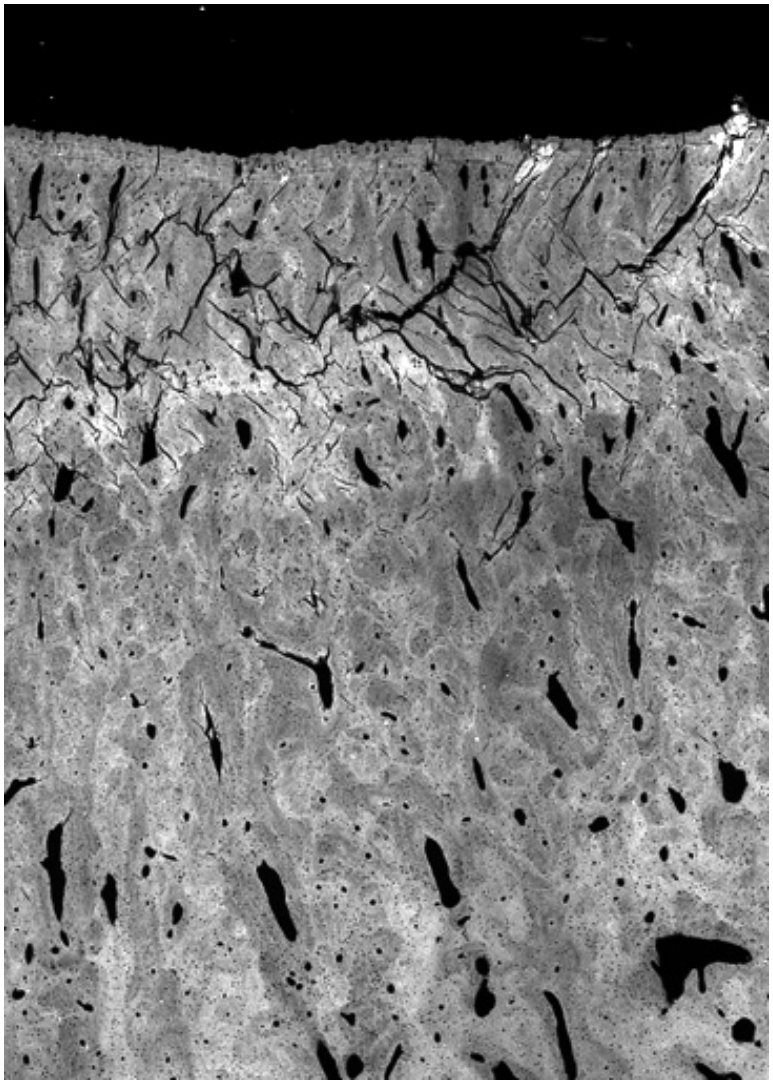


Bone fatigue

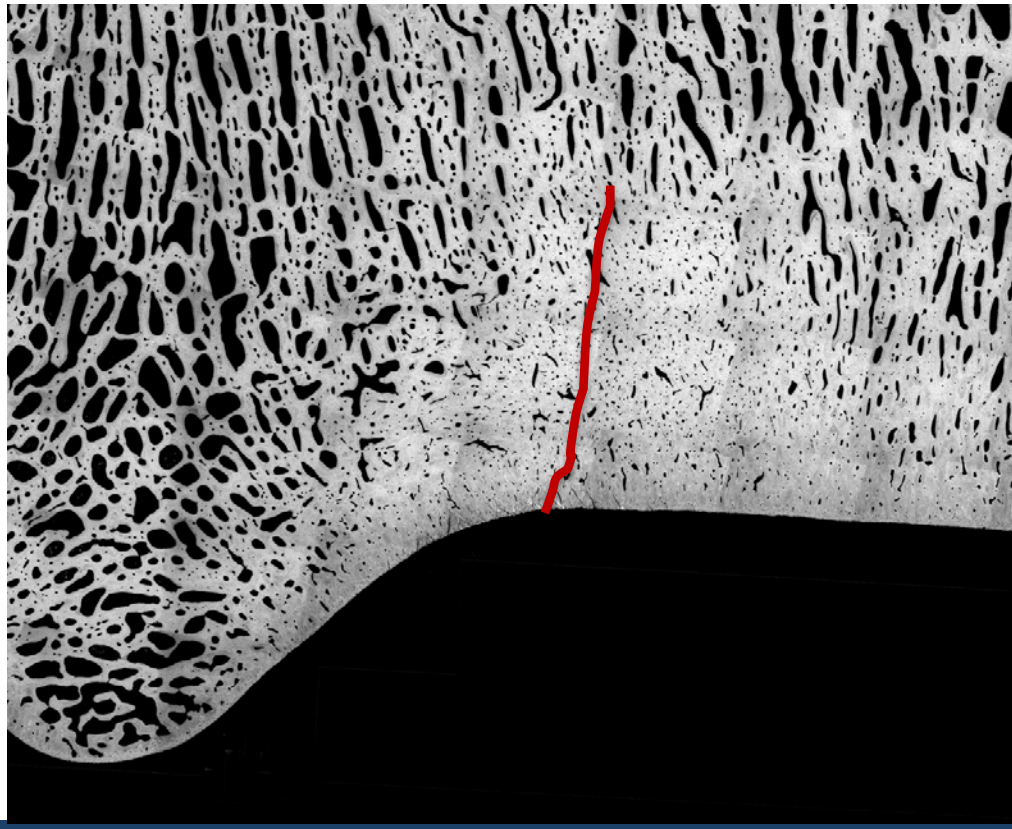
- Damage may be observed as microcracks
- Commonly observed in highly loaded areas

2mm



Bone fatigue

- Microcracks accumulate and grow into fractures



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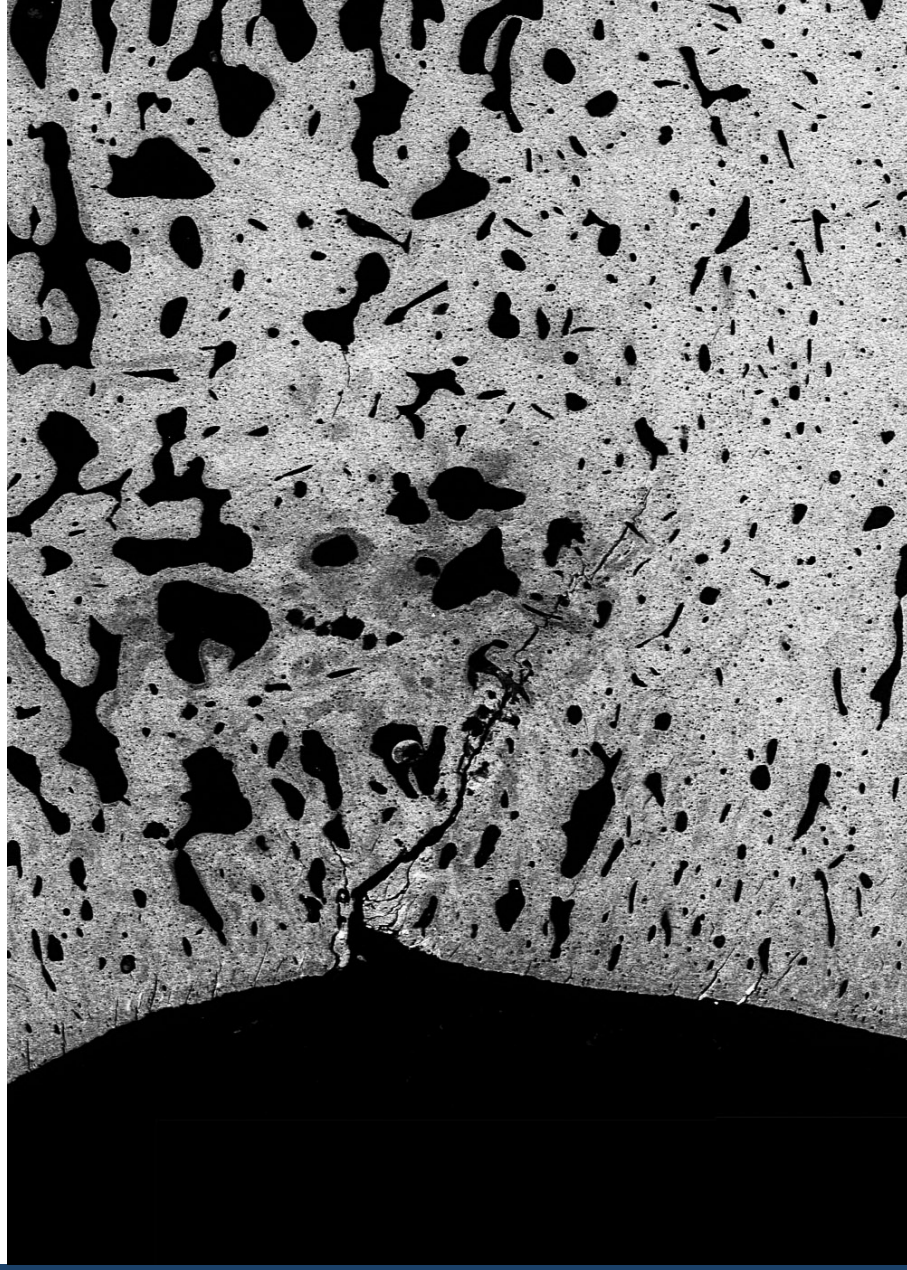


Bone fatigue

- Fractures may progress to catastrophic failure

Risk of fatality

- For Thoroughbred racehorses
  - Longer career
  - Greater number of races in career
  - Greater number of races in last 30d
  - Started a race 1-14 days before injury

Accumulation of damage over time

Rapid accumulation of damage

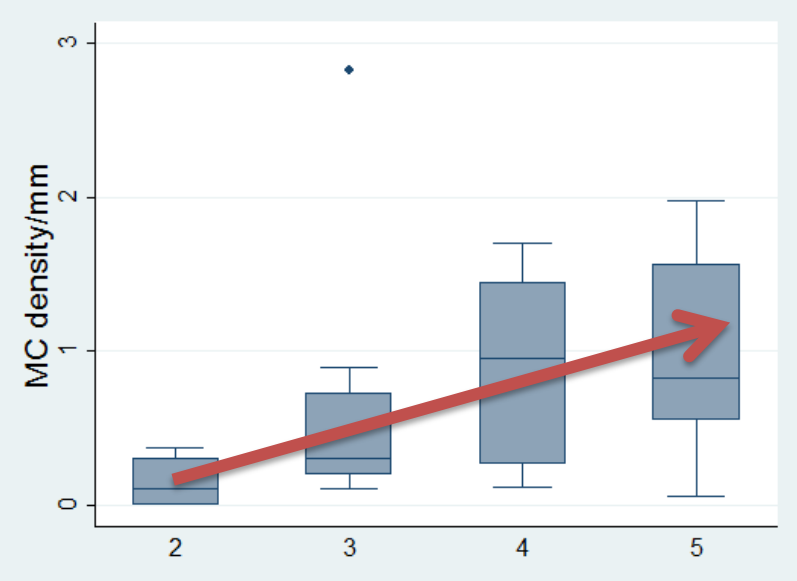
Risk of elimination – lameness

- Endurance horses
  - Less than 90 days between rides

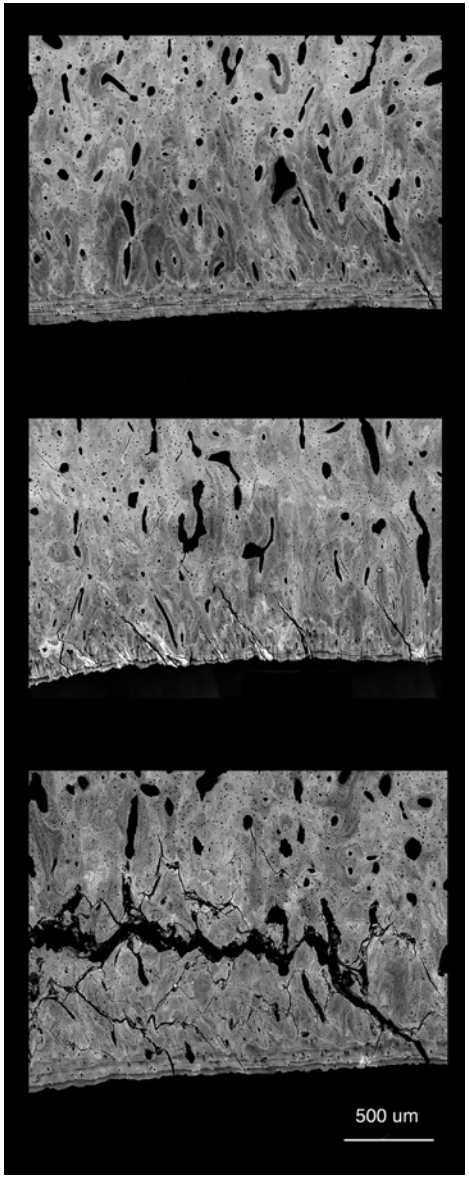
Rapid accumulation of damage

Accumulation of damage

- Density of microcracks higher with:
  - Longer career



Age



Accumulation of bone damage

- Too many kilometres
- Too much distance in too short a time
- Higher speeds

Bone response to cyclic loading

Adaptation

- Net increase in bone volume in response to training

Repair

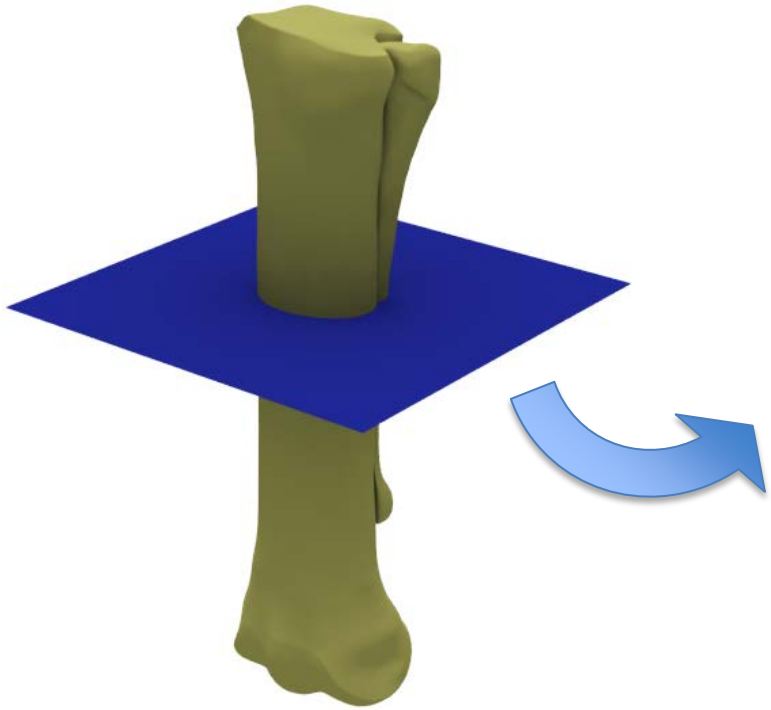
- Removal and replacement of bone
- No net change in bone volume

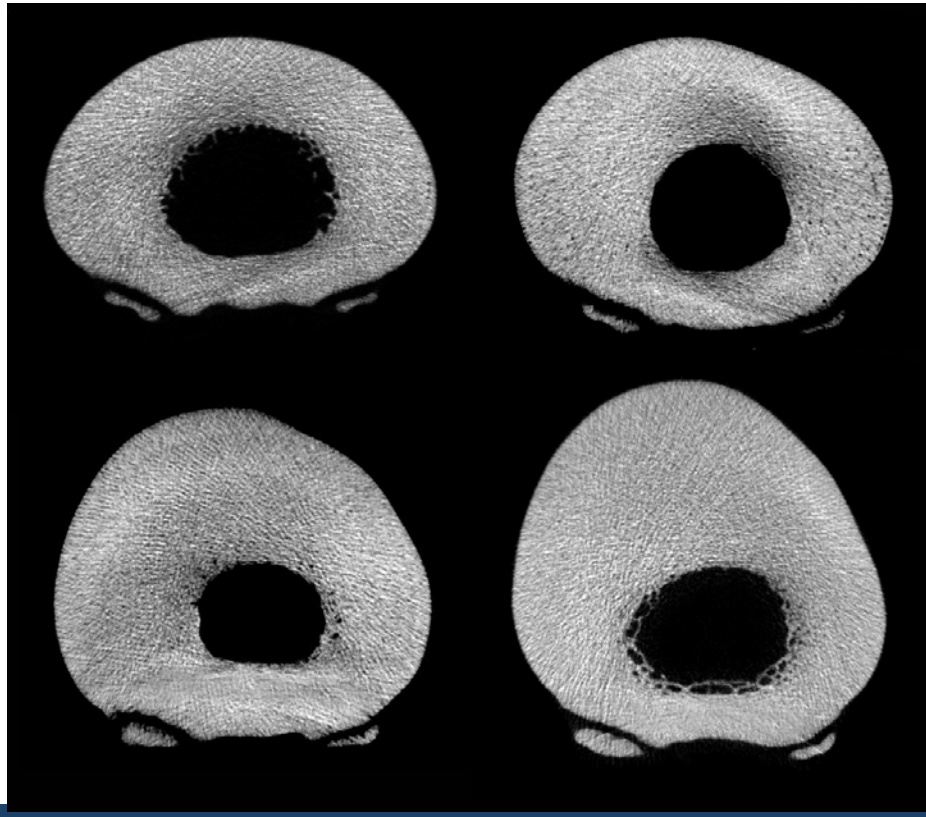
Adaptation of bone

- Bone adapts to loads applied
  - Trotting – adapts bone to trotting
  - Galloping – adapts bone to galloping
- Only requires low volumes of exercise to adapt
  - 2-3 times per week
- When increasing speed reduce distance

Adaptation of bone

- Increases resistance to fatigue





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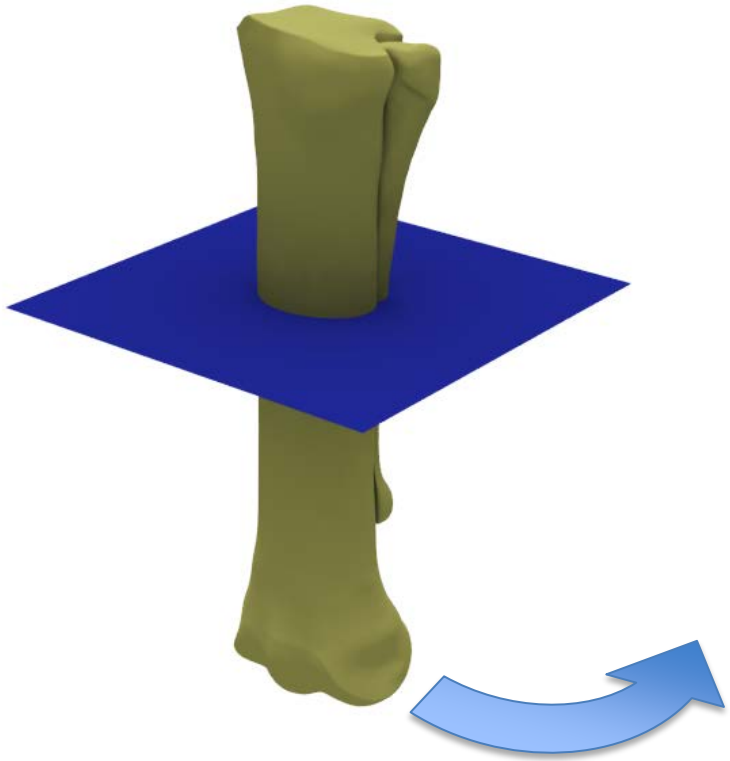
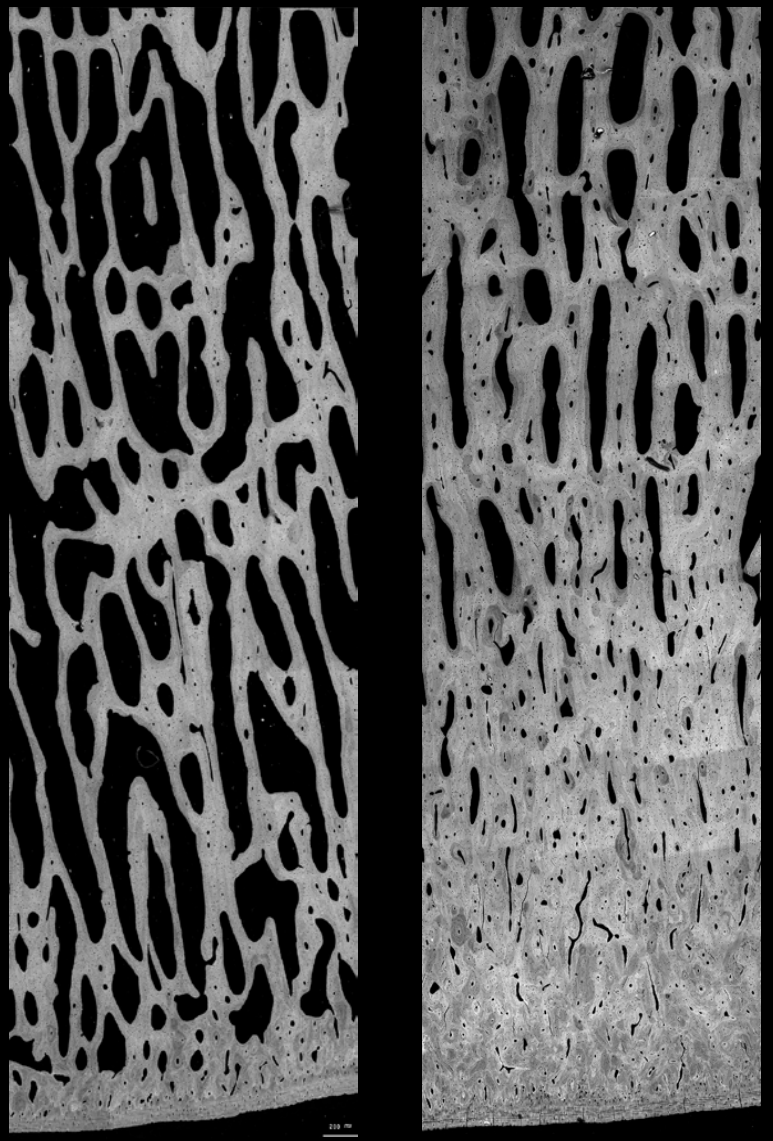
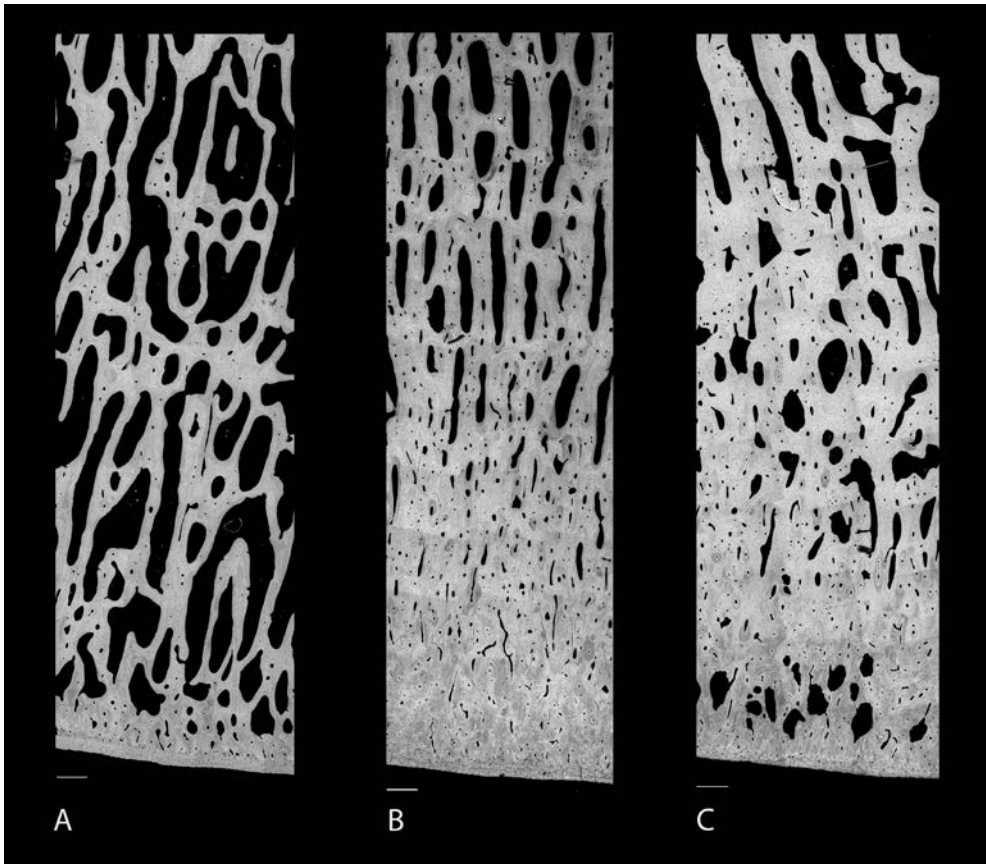




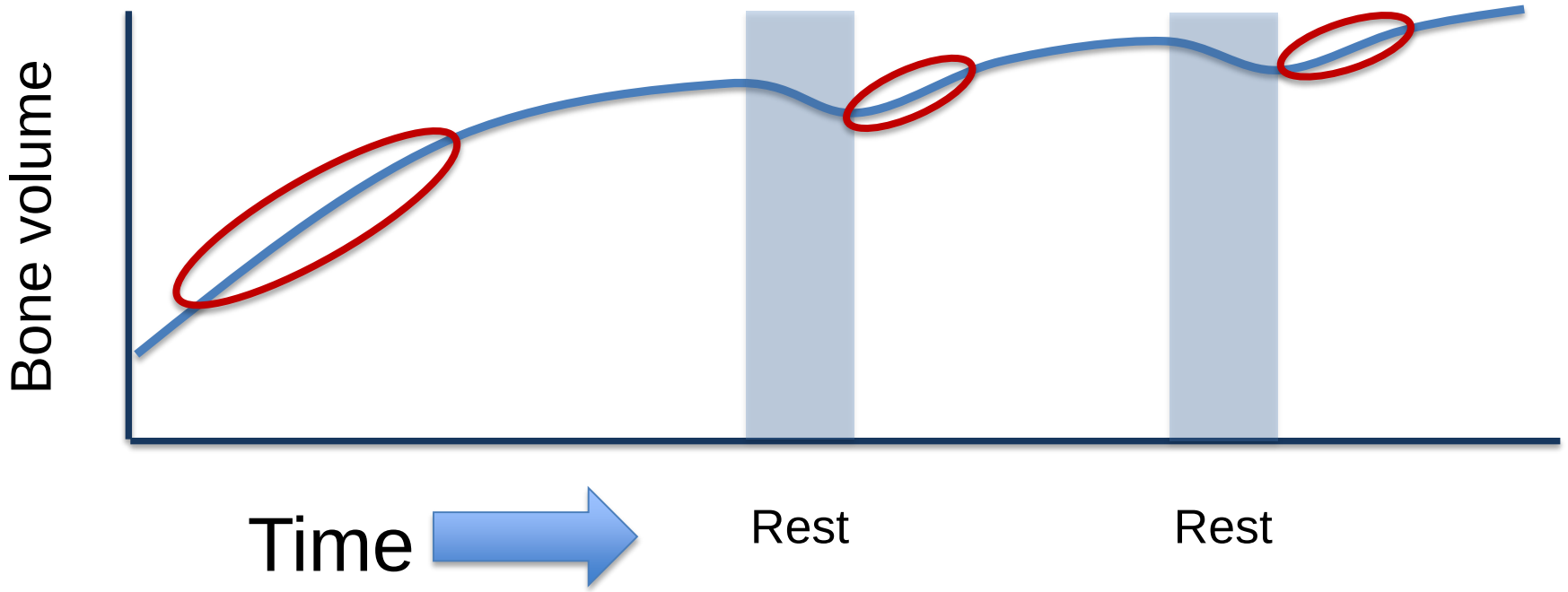
Adaptation of bone

- Risk periods
  - Commencement of training
  - Resumption of training after rest period



Adaptation of bone

- 8-12 weeks to fully adapt

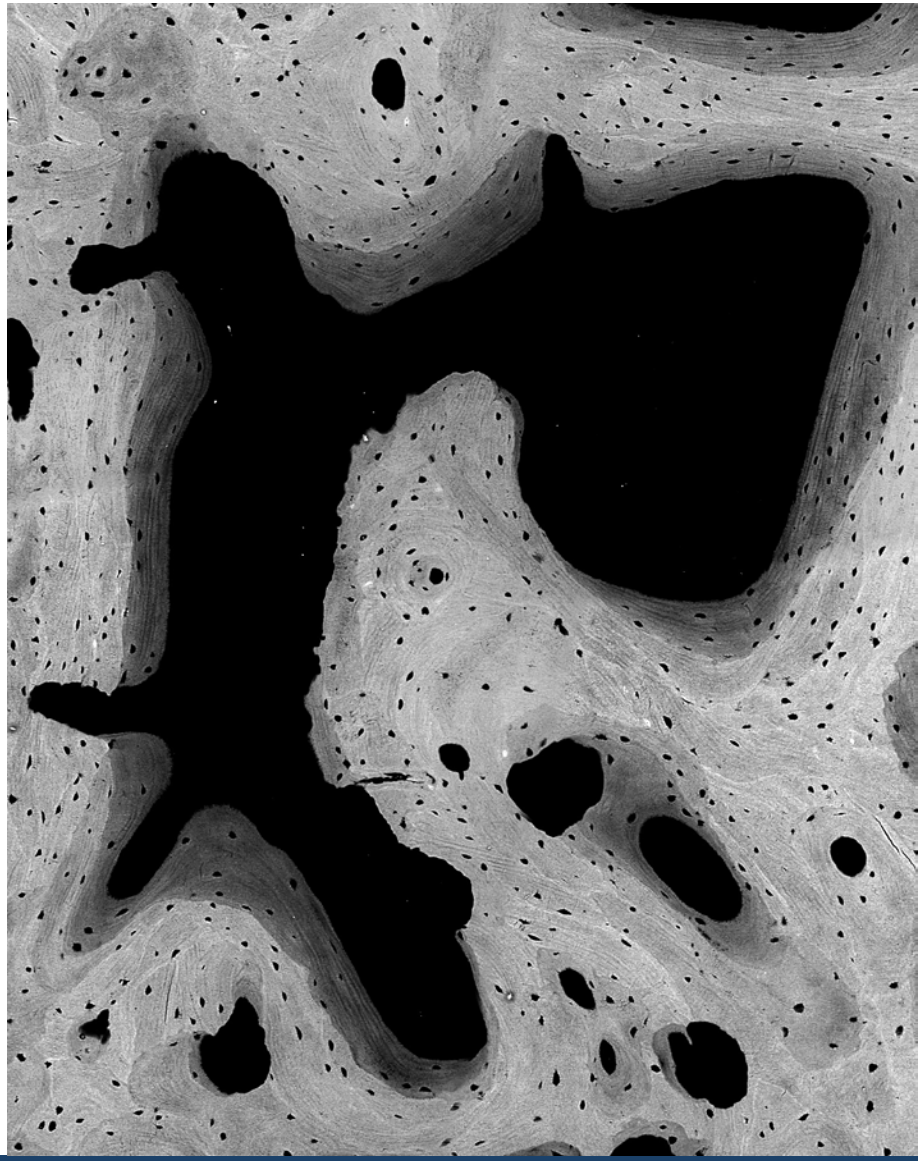


Where we go wrong with adaptation

- Inexperienced horses
  - Too much work too soon
- Large changes in training level
- Adapt to wrong exercise level
  - No galloping exercise prior to competing

Repair of bone

- Constant process of bone renewal
  - Very effective at increasing fatigue life



Bone repair

- Removal and replacement of bone
- Normal process

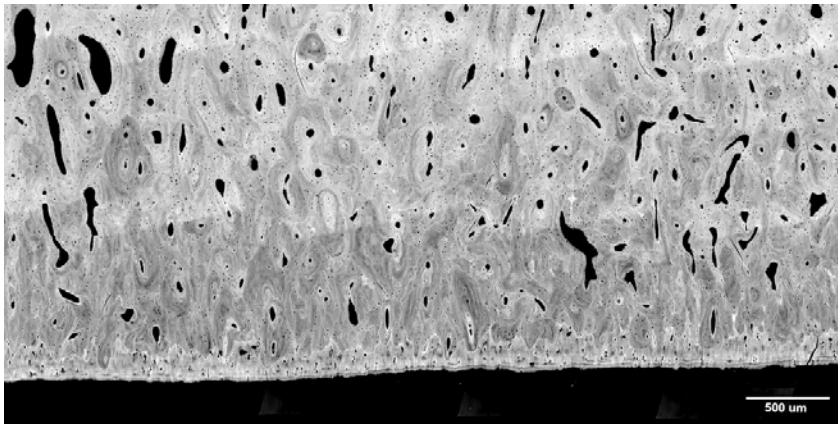
Bone repair

- Removal and replacement of bone
- Normal process

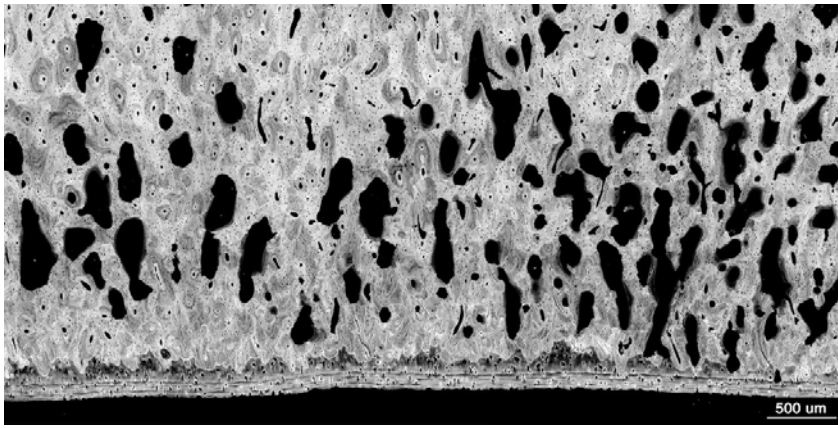
Training inhibits bone repair

- Majority of repair occurs when horses are resting (no training or competing)

Training

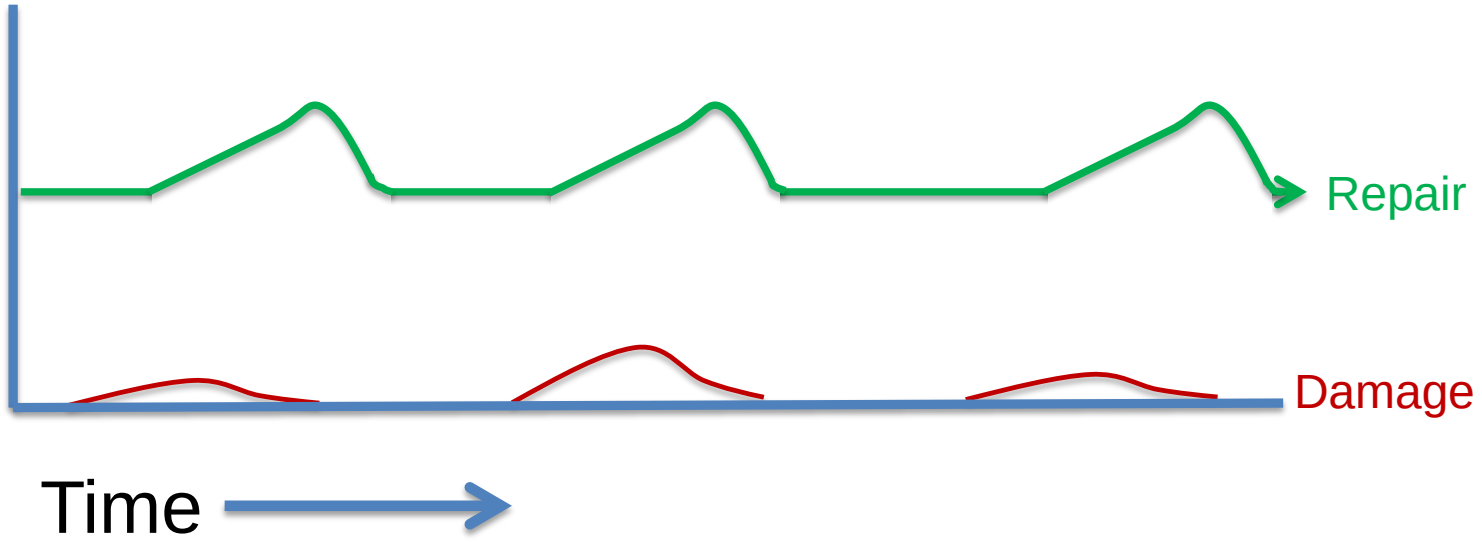


Resting



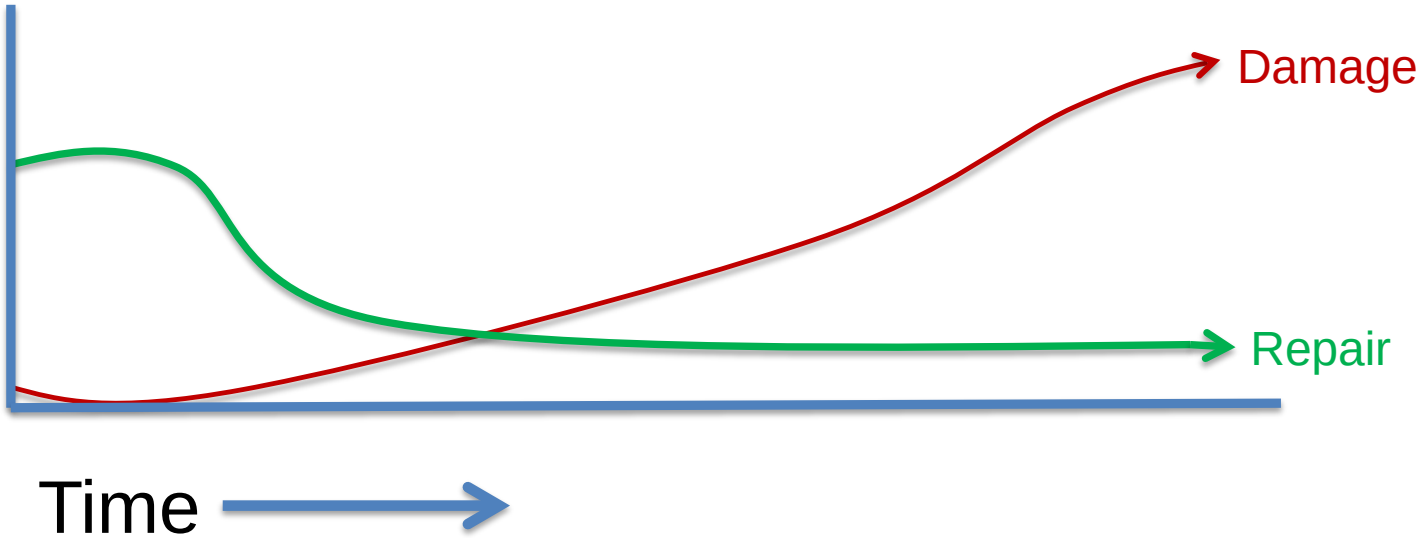
Bone repair

- Resting horse (no training or competing)
  - Constantly replacing bone
  - Repair increased in response to damage

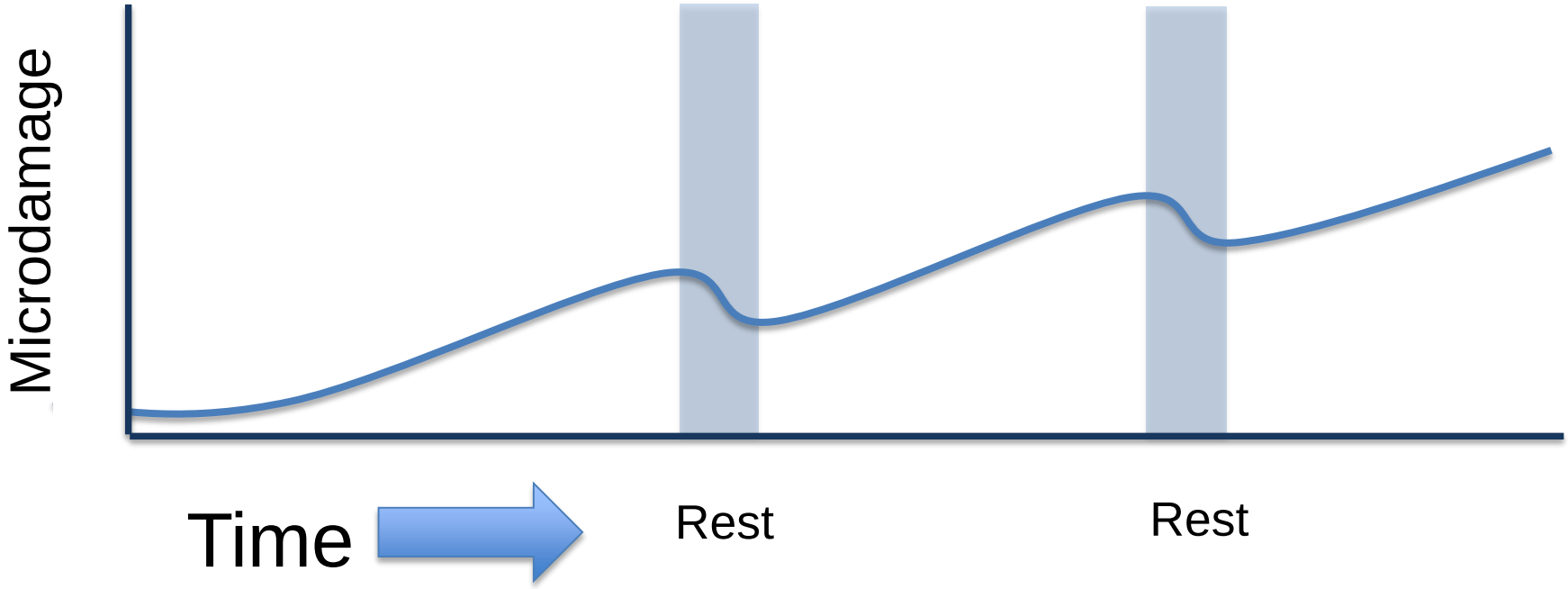


Bone repair

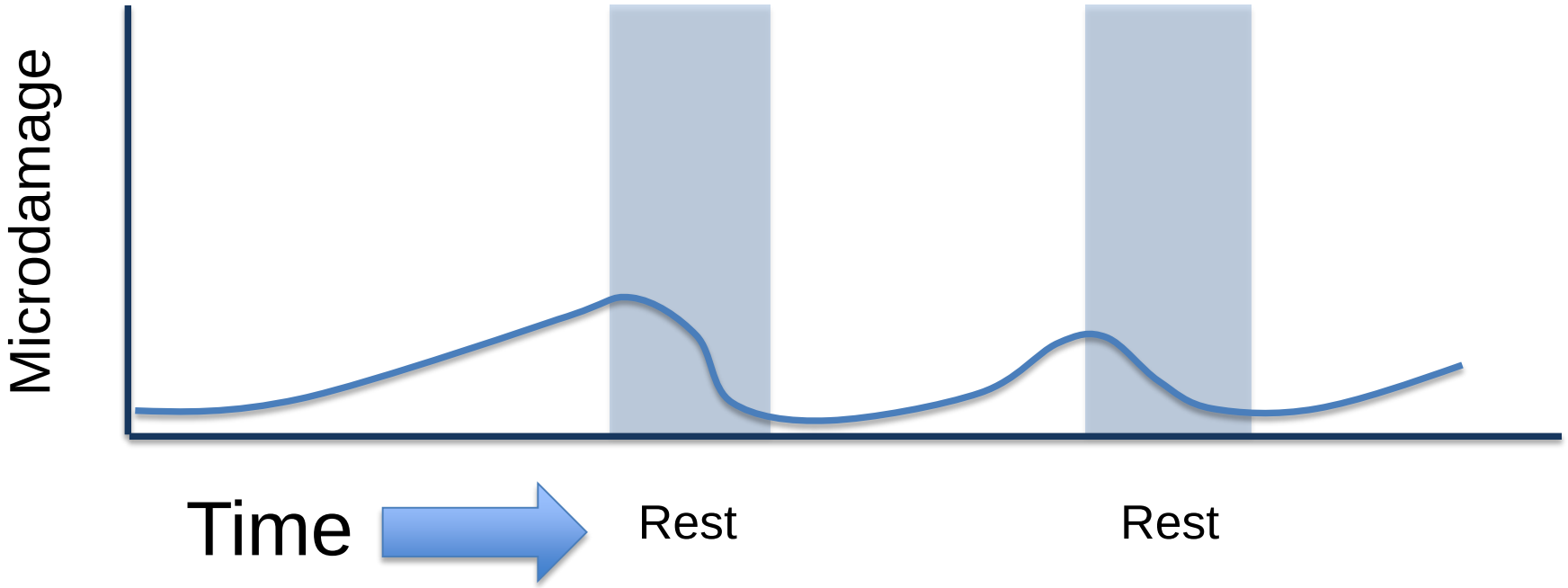
- Intensive training
  - Damage accumulating
  - Repair reduced
  - Severity of inhibition of repair depends on frequency and intensity of high speed exercise



Bone repair



Bone repair



Where we go wrong with bone repair

- Inhibit remodelling too much – training too intense
- Training and competing periods too long
- Not enough recovery time to allow bone repair

Do less

- Minimize the distance of speed work needed to keep horse fit
- More time between competitions
- Shorter training and competing periods
- Longer rest/recovery periods (not training)

Conclusions

- Injuries are not random events out of our control
- Horses in training and competition are accumulating damage
- There are limits to the amount of fast work horses can sustain
- Need to balance training periods and non-training periods to allow recovery
- Need to adapt bone to what it has to do

Conclusions

- Mindset of all participants in the sport
  - The horse is an elite athlete
  - Equine athletes work at the limits of biology
  - The equine skeleton has limits
    - If in doubt proceed with caution
    - Be attuned to the signs of bone pain
    - Absence of lameness, negative radiographs does not mean there is no problem
    - Recovery time essential

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