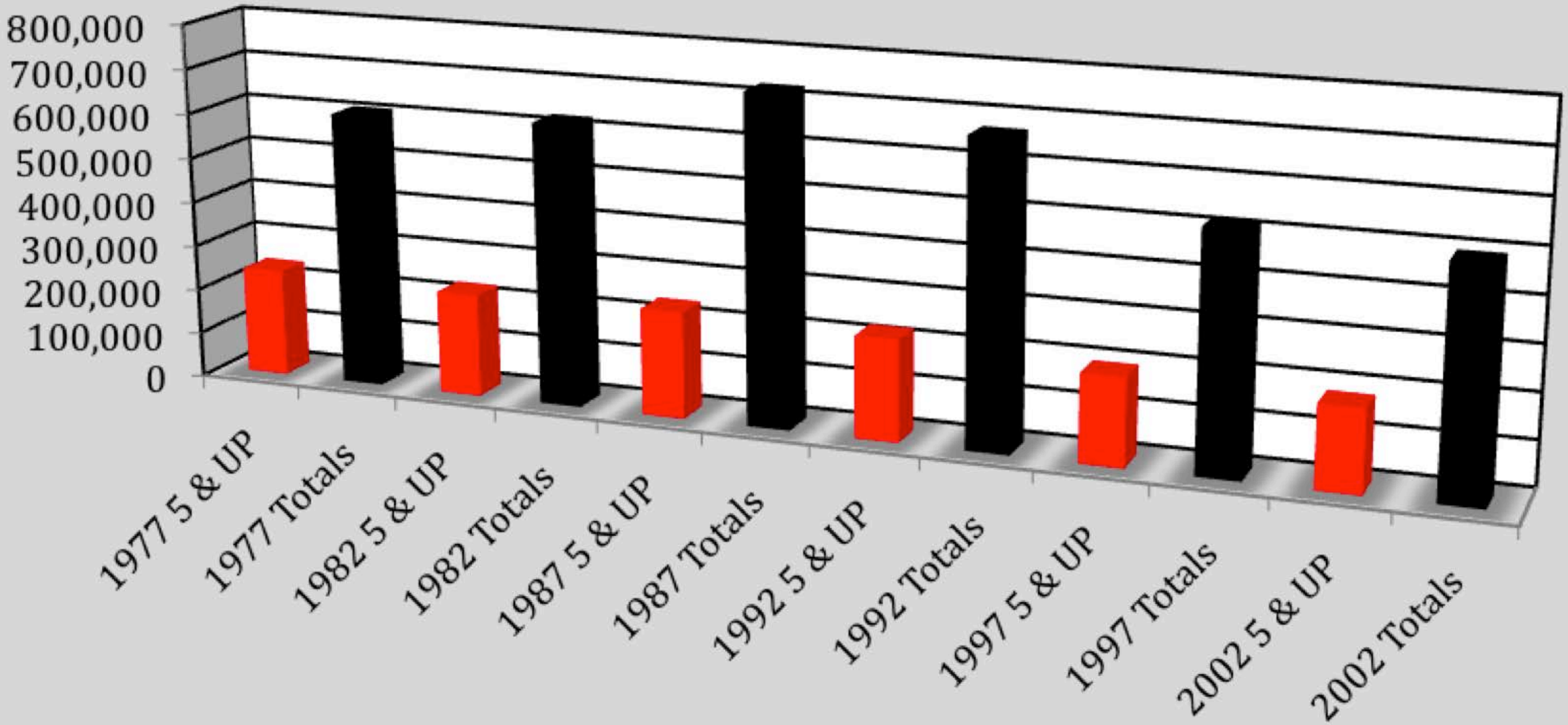
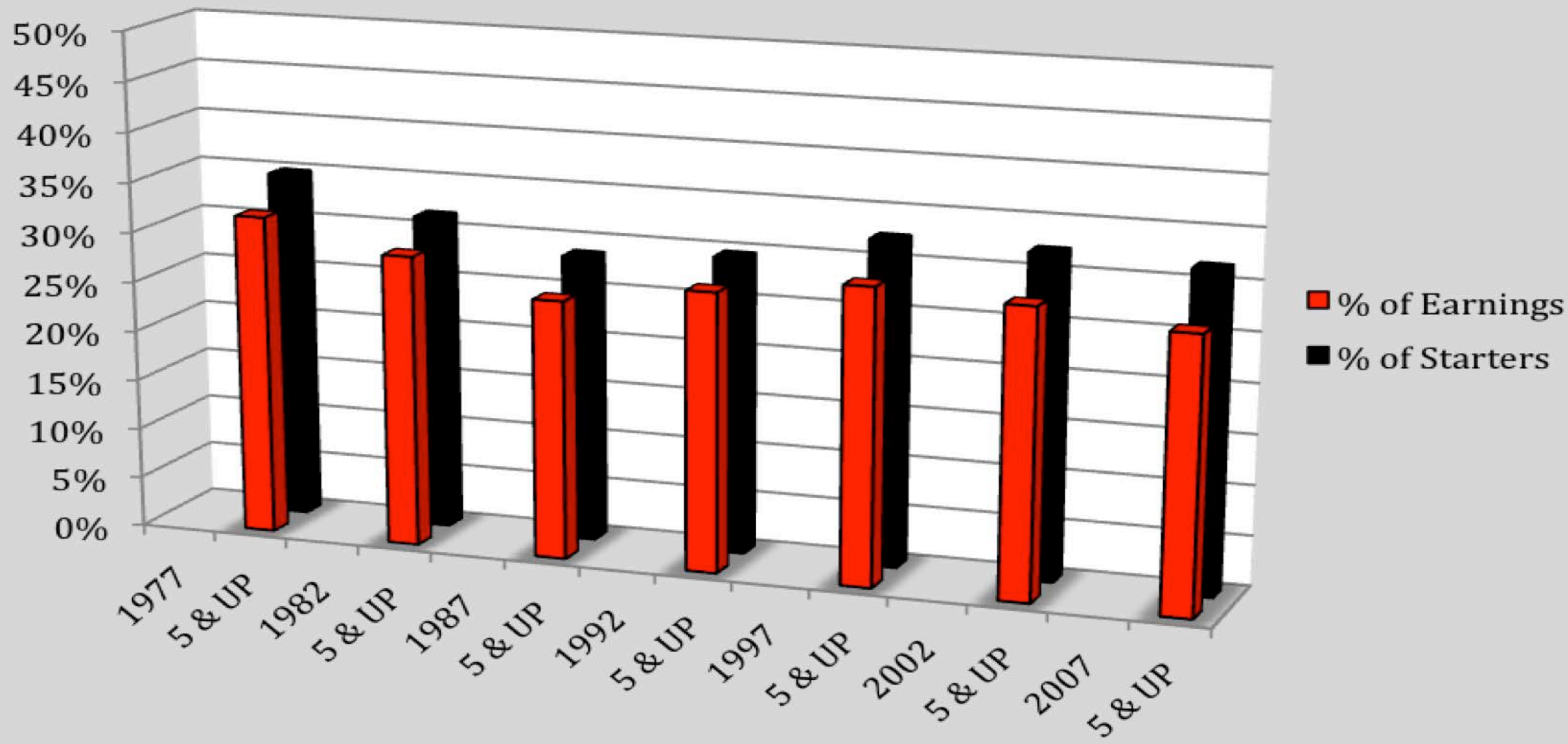
Approaching Training to Minimize Wear and Tear

L.R. Bramlage DVM MS

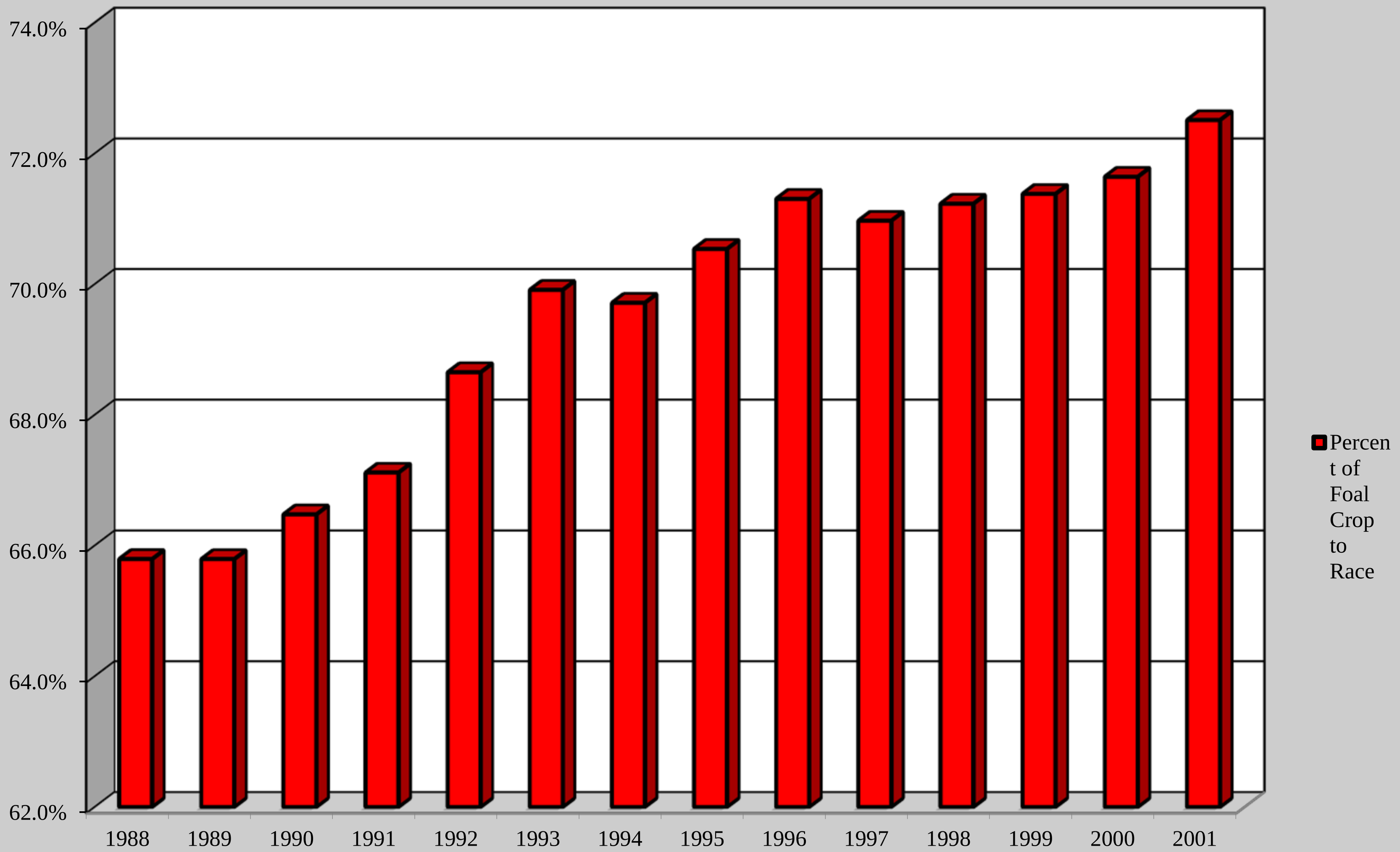
All Starts vs. Starts by aged Aged Starters



Aged Starters Percent of Starters and Percent of Purses



Percent of Foal Crop to Race



Bone once thought to be inert

- Actually, very dynamic
- Highly sophisticated
- Remarkably adaptable

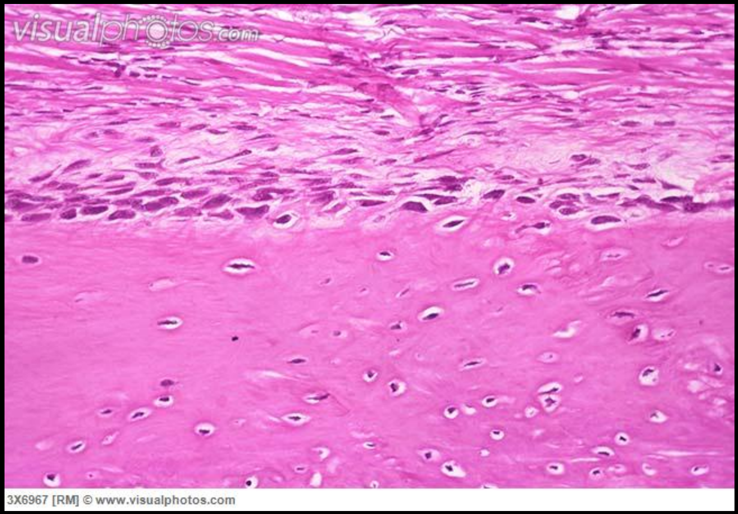
- Two cell lines
  - Osteocytic
  - Osteoblastic

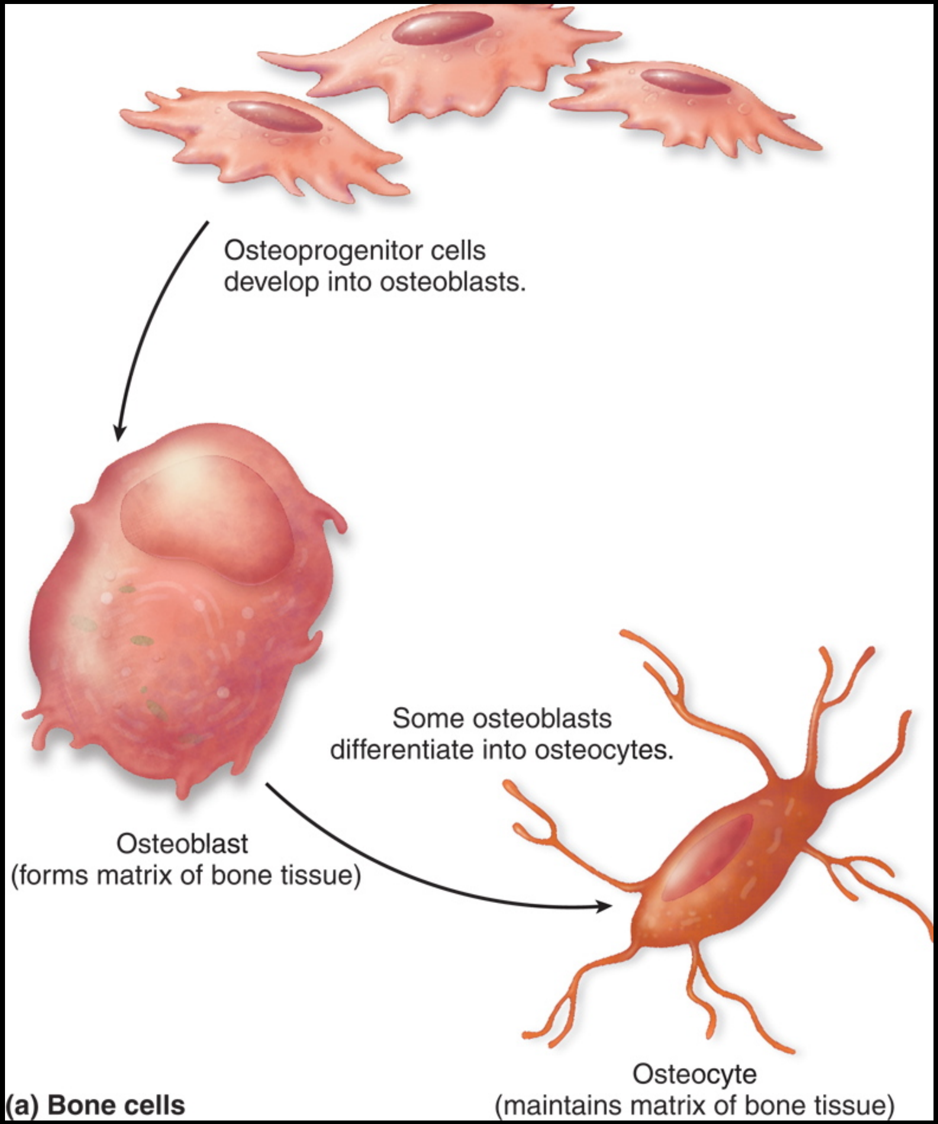



Skeletal Phenotype is Genetic

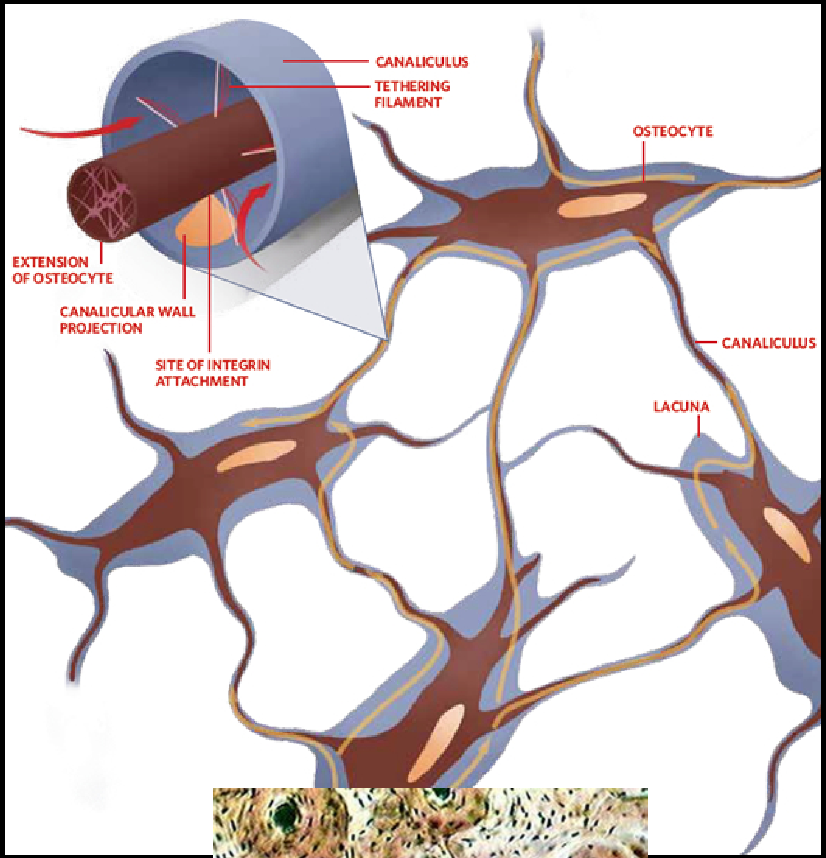
- Refinement dictated by biomechanics
- Modeling is work specific
- But, how does it occur

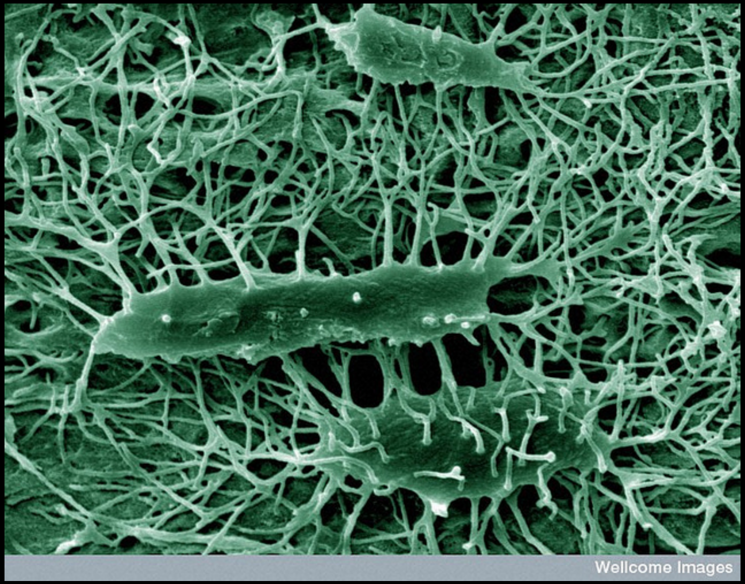
Osteoblast/Osteocyte Line

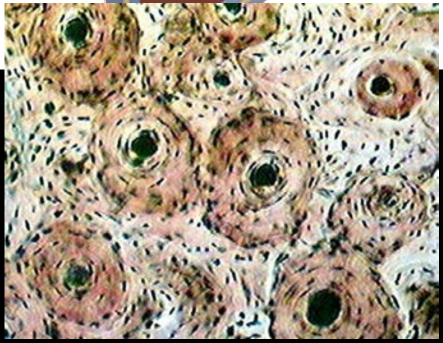


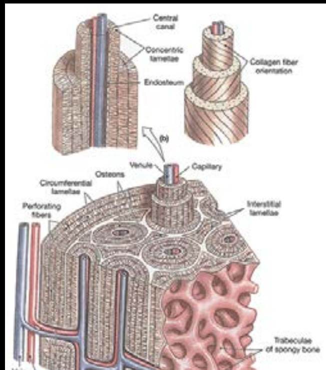


Osteocyte, Prisoner or Director



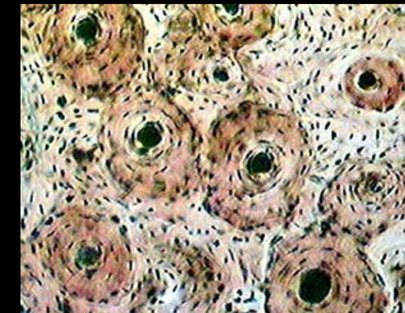


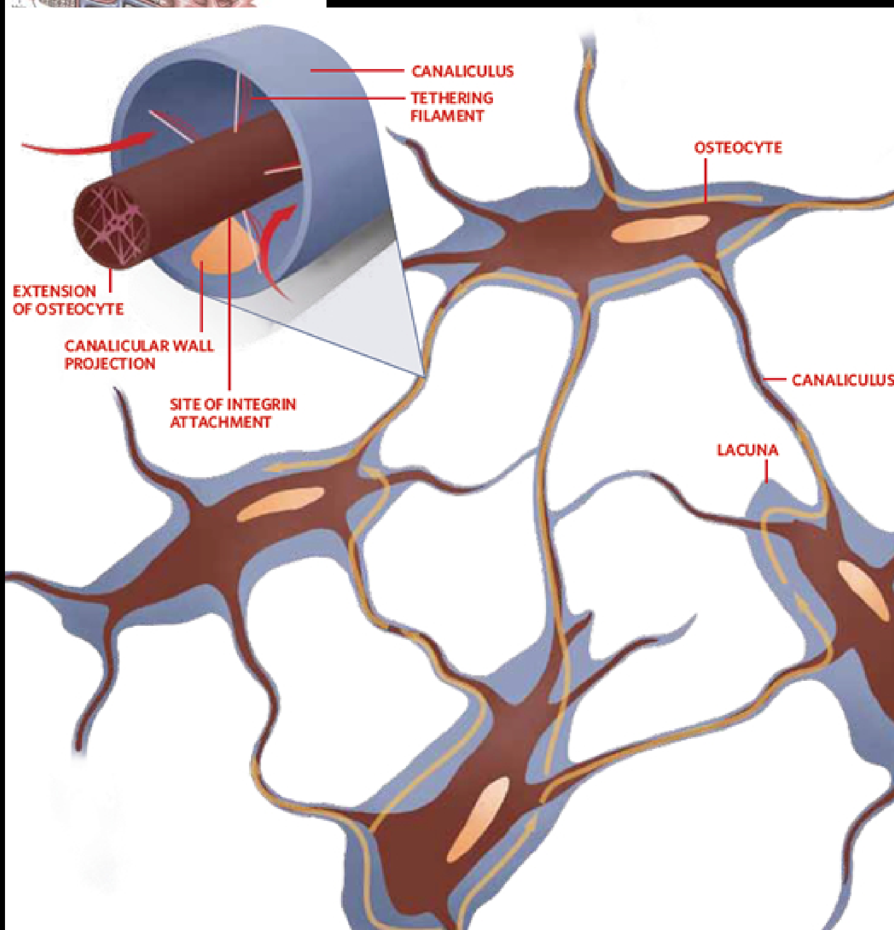




Director!

The Osteocyte detects the mechanical loading

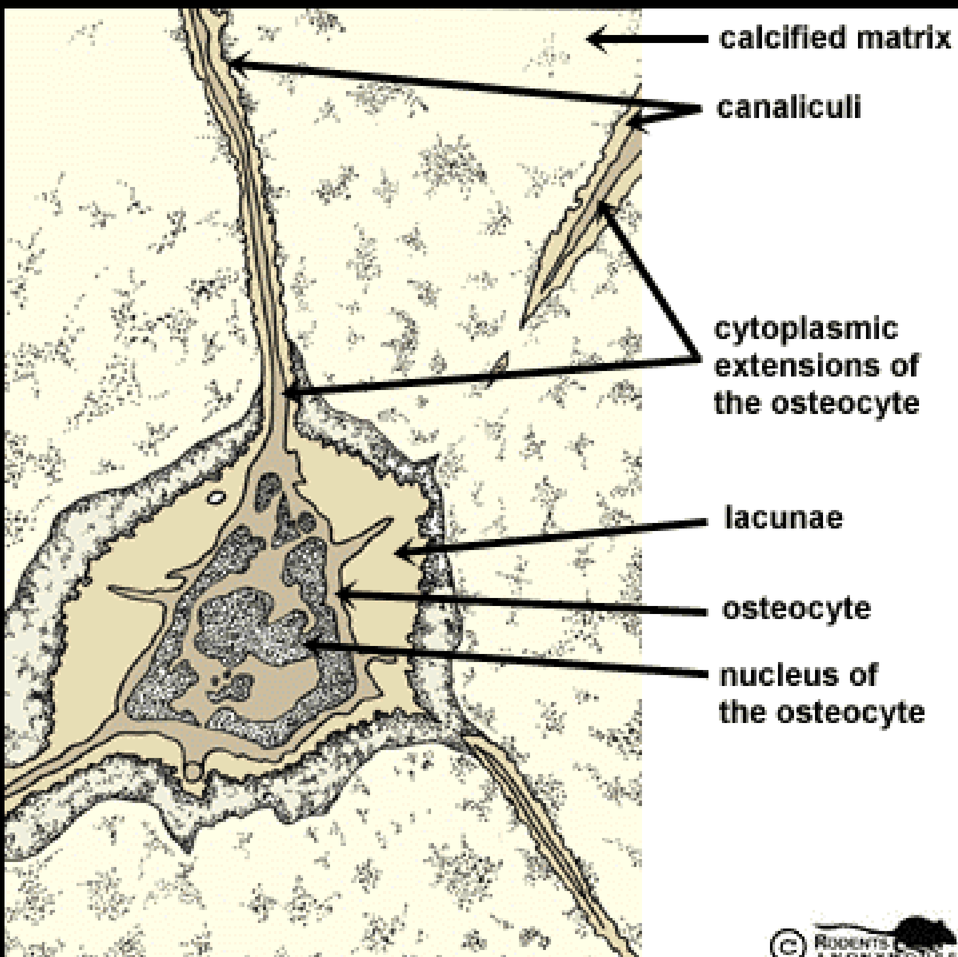


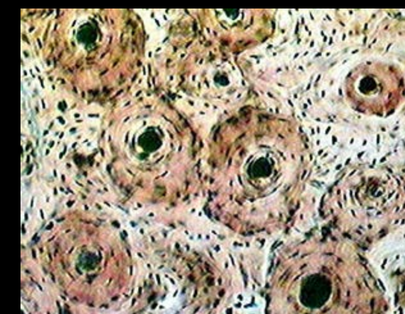


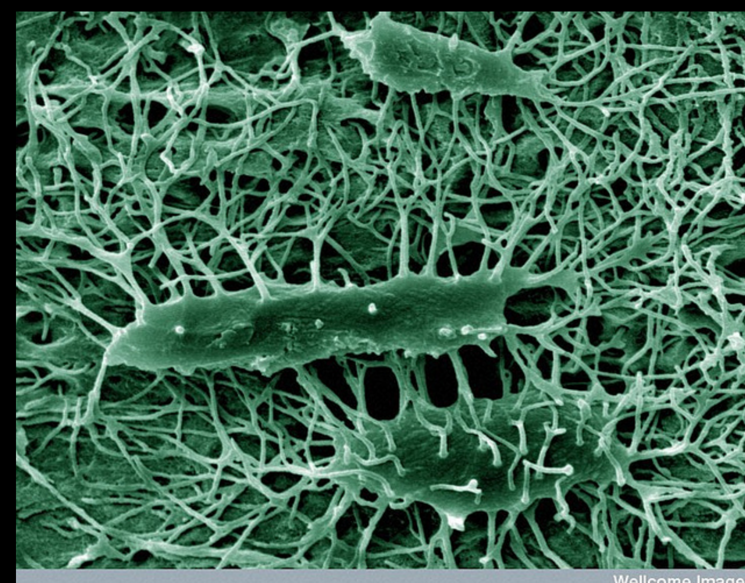
Canaliculi are the key

Canaliculi

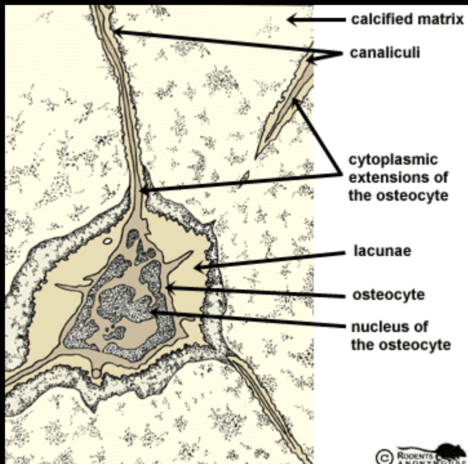
- Sense biomechanical loads
- Allow rapid bone dissolution and formation



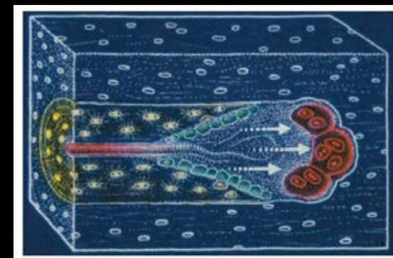


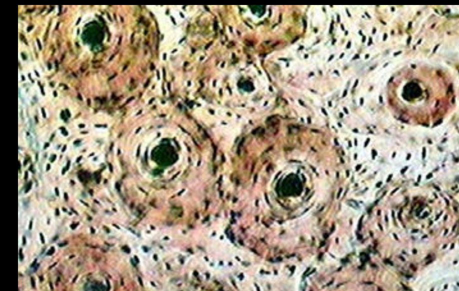


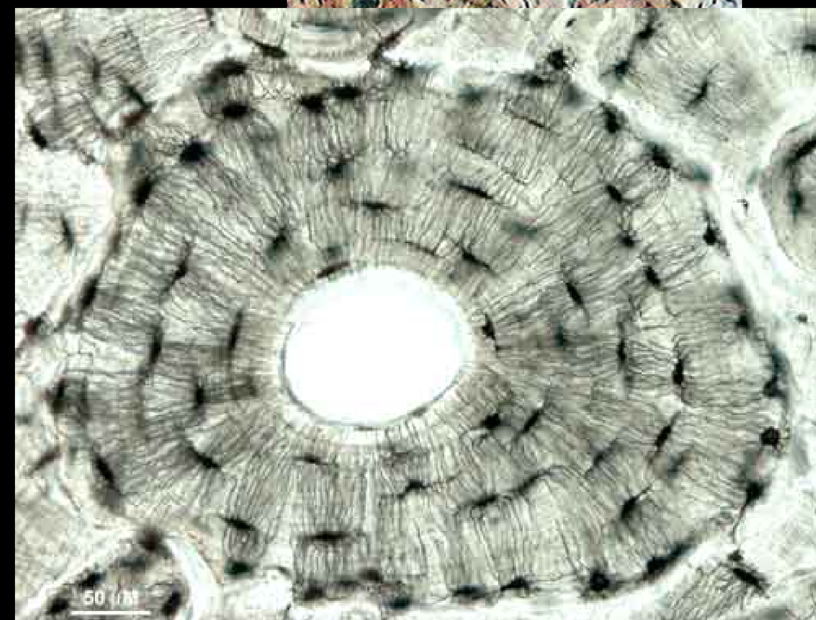
Bone mineral content increases over time

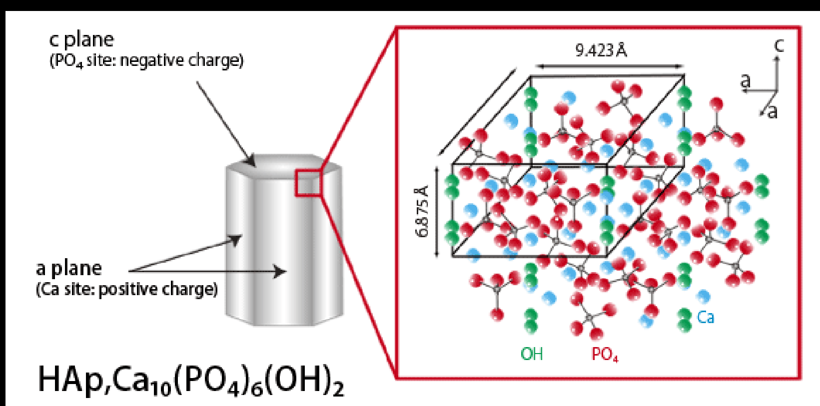


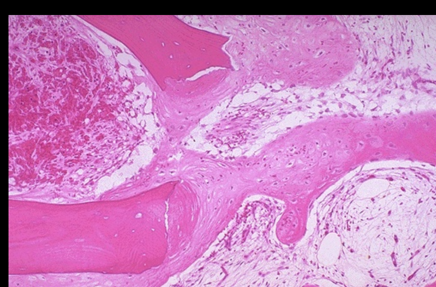
50µm









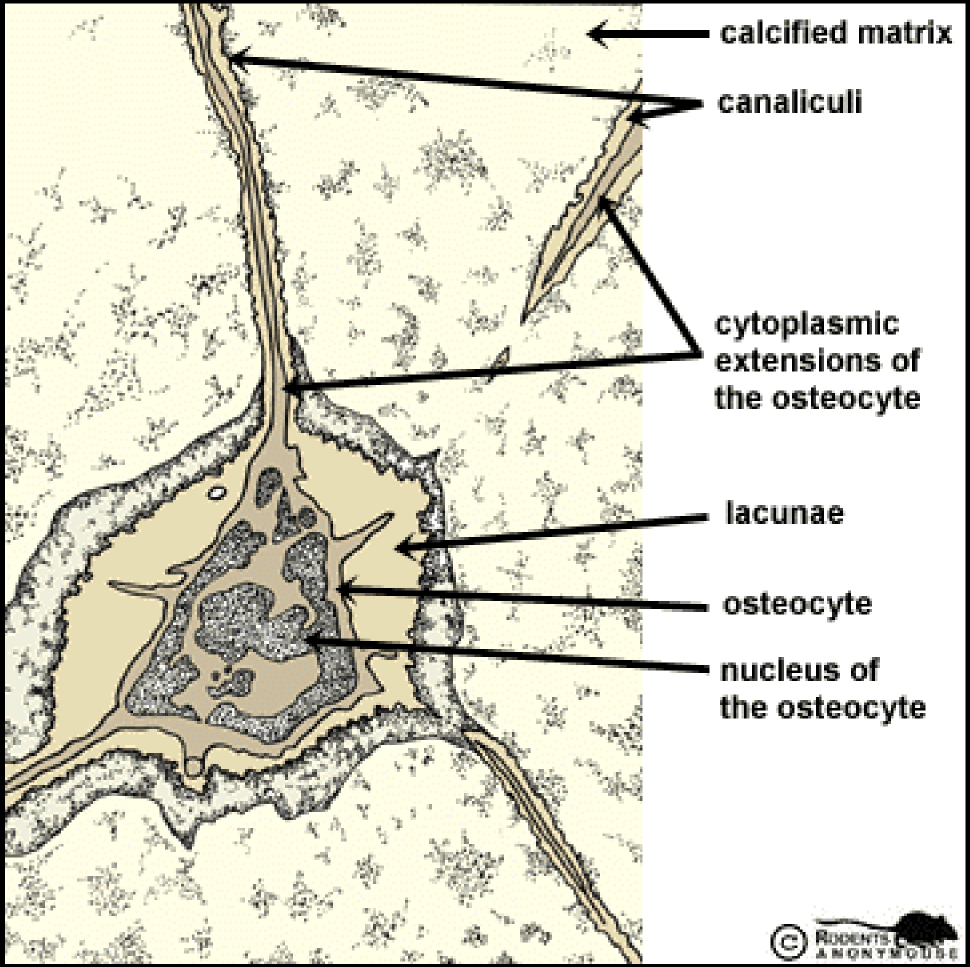


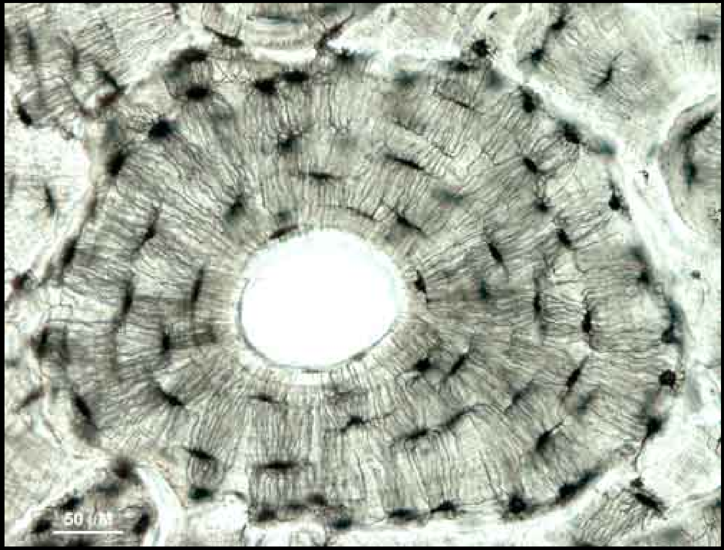
Osteoblast → Osteoid

Secretes mineral component

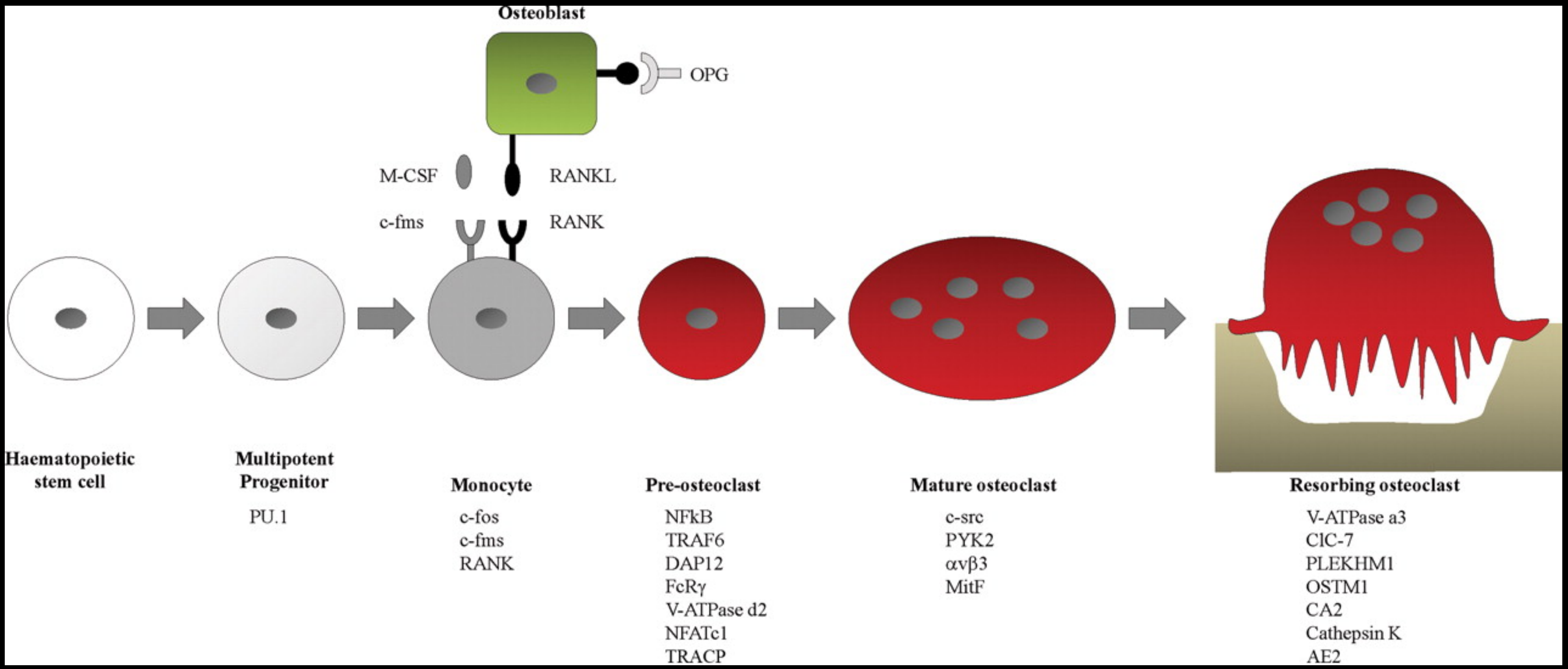
Increases bone / unit volume

Bone becomes stronger and less ductile over time



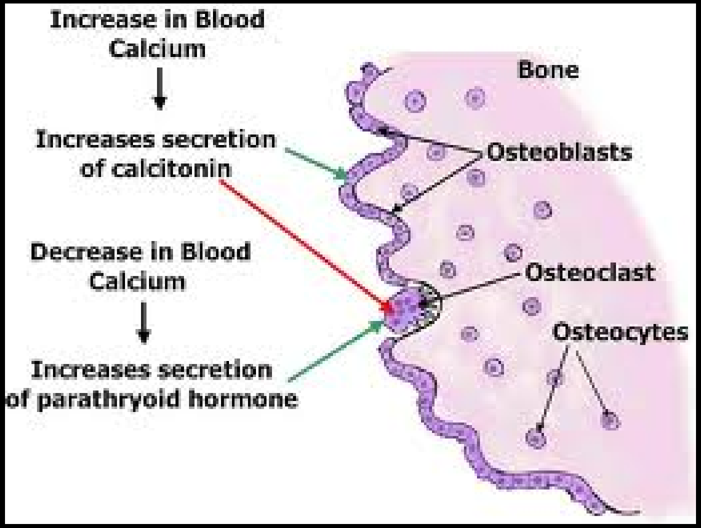


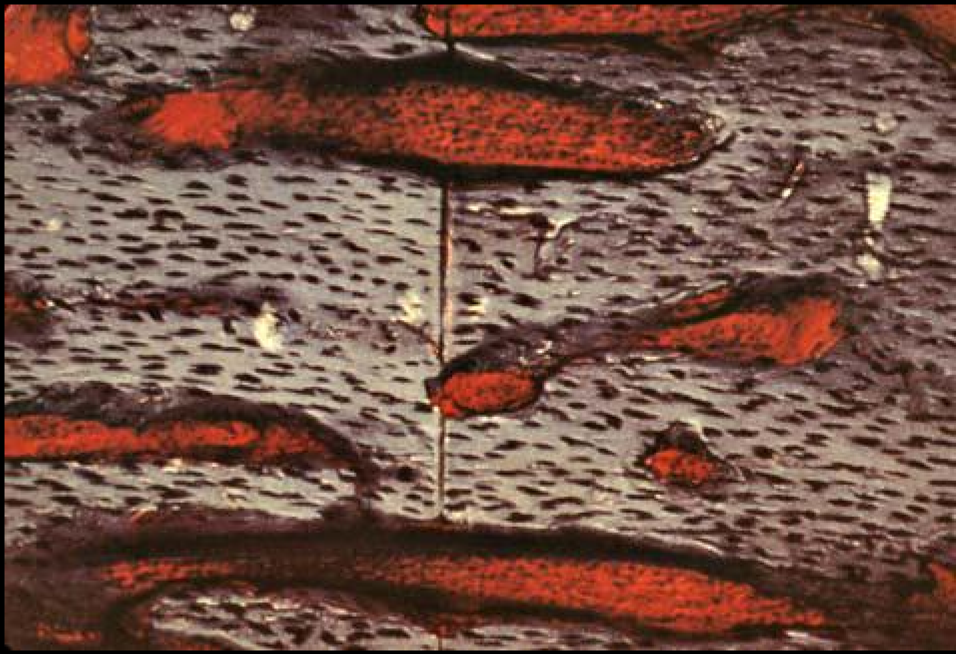
Osteoclast



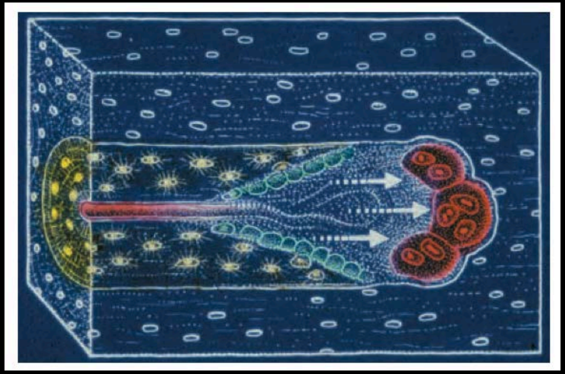
ENDOCRINE
REVIEWS

Osteoclasts



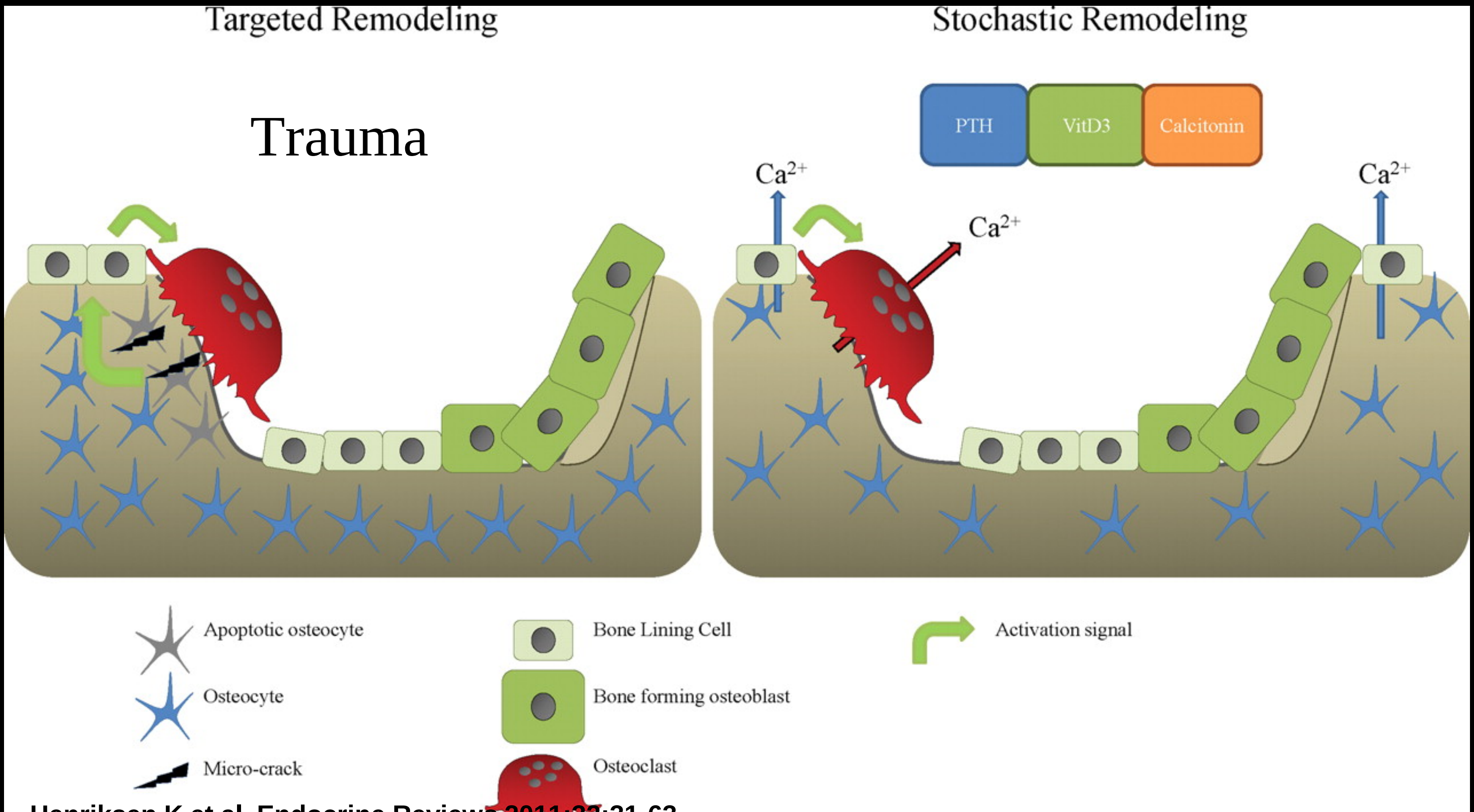


50µm



Osteoclasts “eat” bone

Osteoclast control,
the lack of osteocytes stimulate

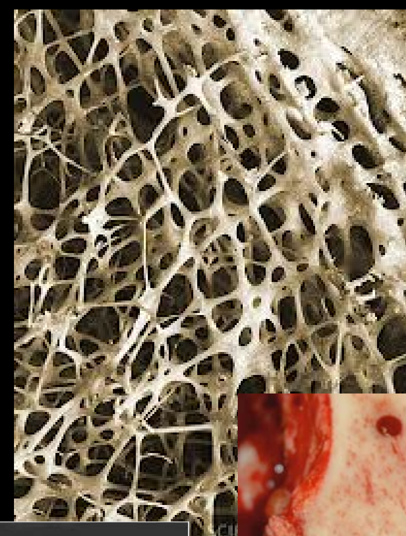


Henriksen K et al. Endocrine Reviews 2011;32:31-63

ENDOCRINE REVIEWS

Options for increasing bone strength in response to training

- Modeling
  - Bone shafts
- Remodeling
  - Bone shafts and cavities

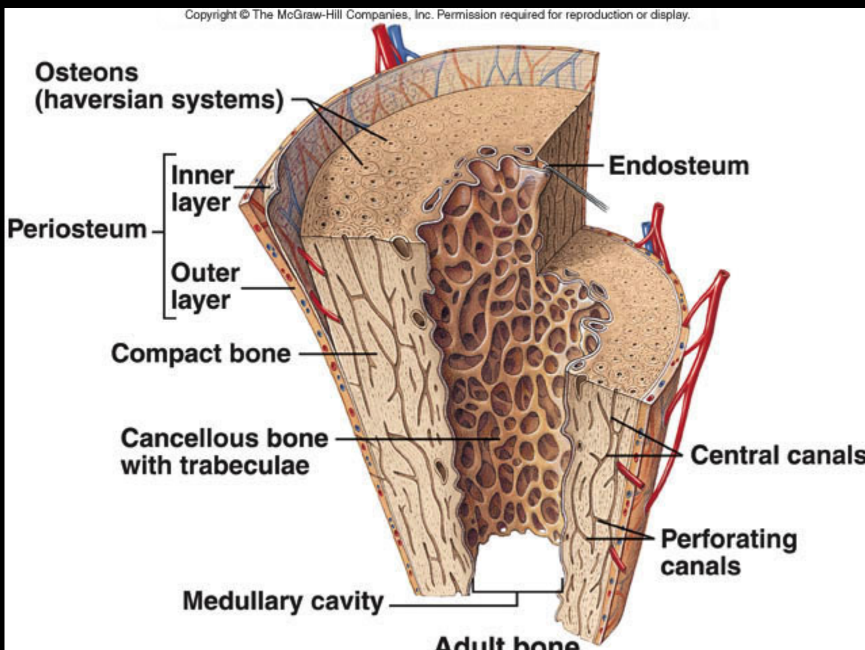



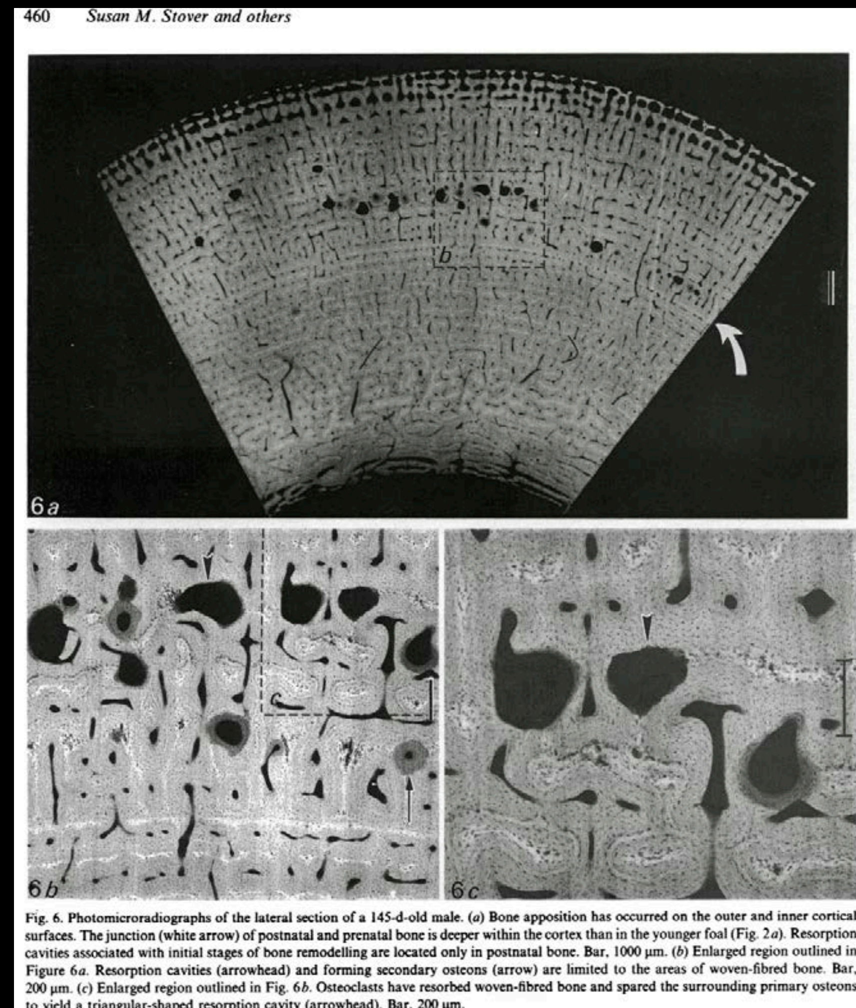


Equine Modeling is Extreme

the cannon bone is the “poster-child”

Prenatal and postnatal bone





460 *Susan M. Stover and others*

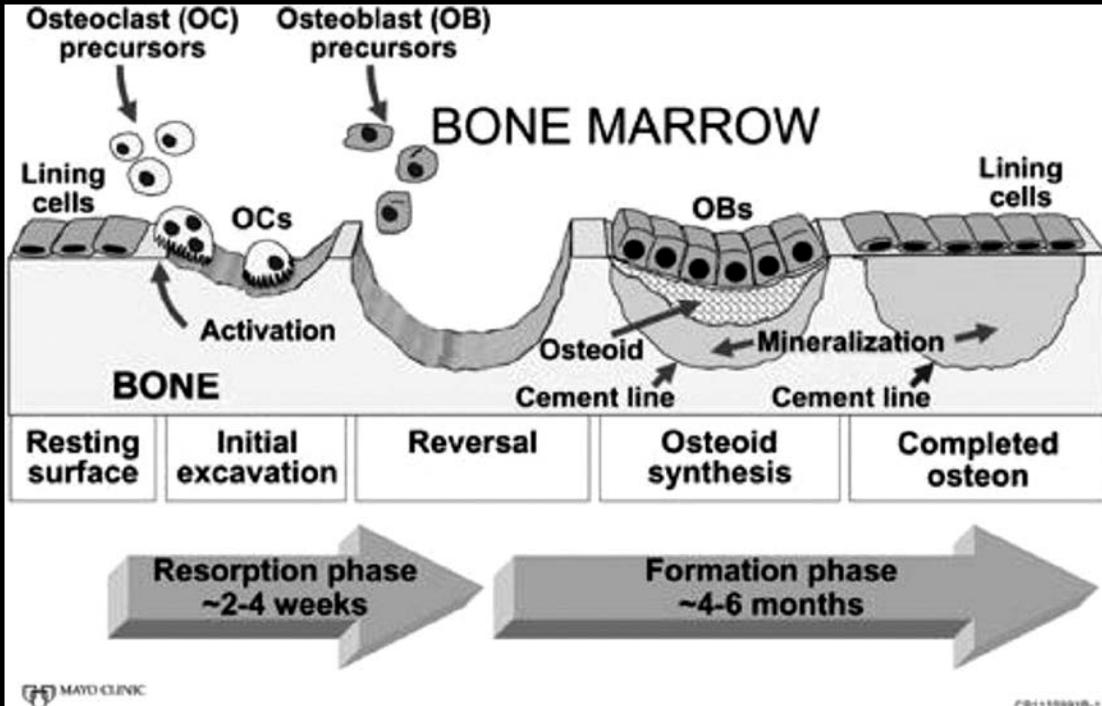
6a

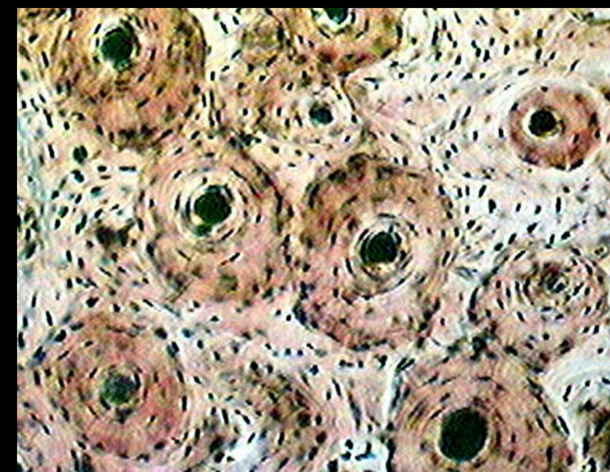
6b

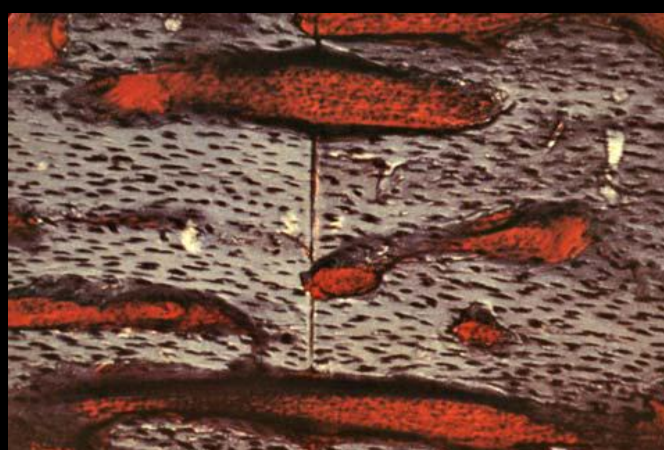
6c

Fig. 6. Photomicroradiographs of the lateral section of a 145-d-old male. (*a*) Bone apposition has occurred on the outer and inner cortical surfaces. The junction (white arrow) of postnatal and prenatal bone is deeper within the cortex than in the younger foal (Fig. 2*a*). Resorption cavities associated with initial stages of bone remodelling are located only in postnatal bone. Bar, 1000 µm. (*b*) Enlarged region outlined in Figure 6*a*. Resorption cavities (arrowhead) and forming secondary osteons (arrow) are limited to the areas of woven-fibred bone. Bar, 200 µm. (*c*) Enlarged region outlined in Fig. 6*b*. Osteoclasts have resorbed woven-fibred bone and spared the surrounding primary osteons to yield a triangular-shaped resorption cavity (arrowhead). Bar, 200 µm.

Remodeling

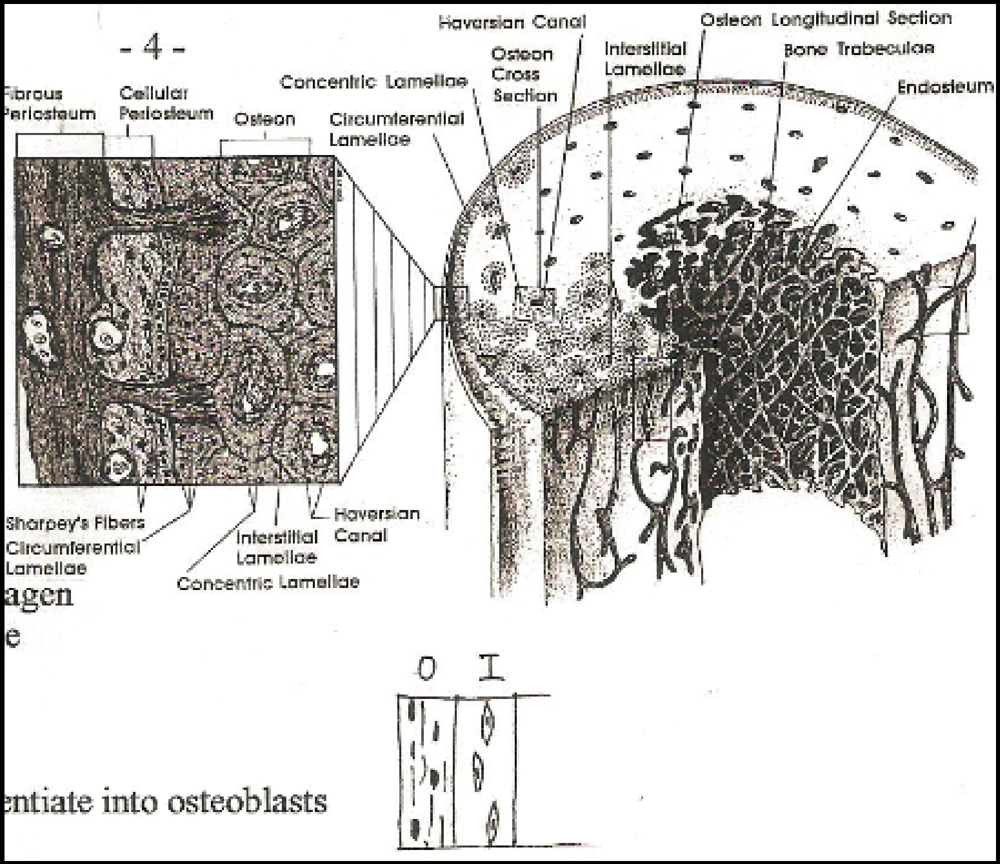






Bone remodels very little during active training.

In periods of high stress osteoclasts are turned off and bone production predominates

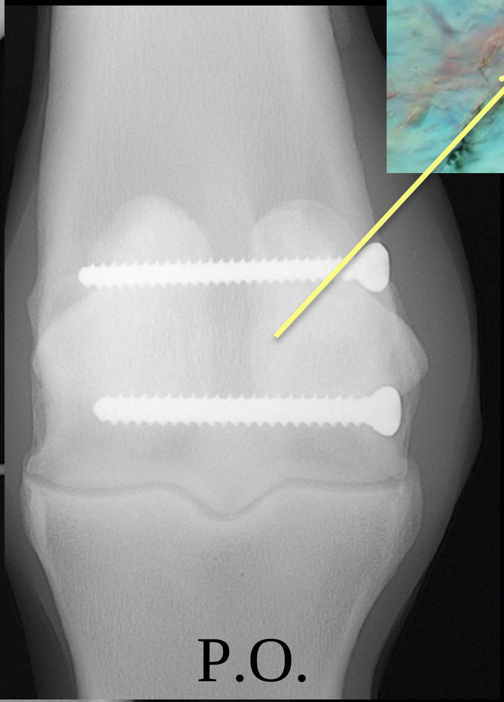


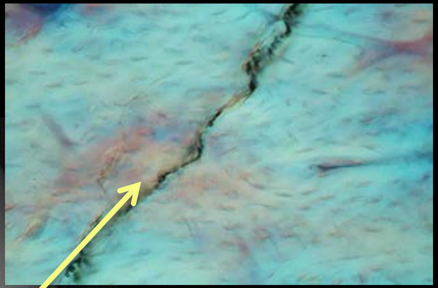
Exercise creates a remodeling debt

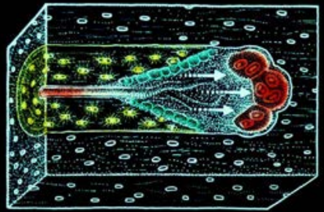
Can be accumulated to a degree

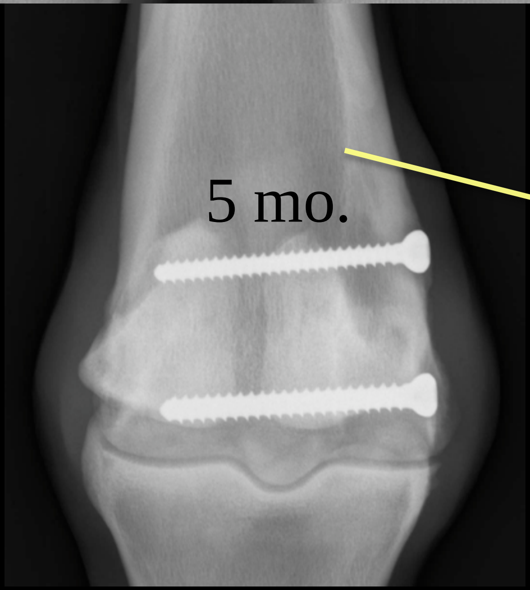
At some point the debt must be erased

If not the bone will fail



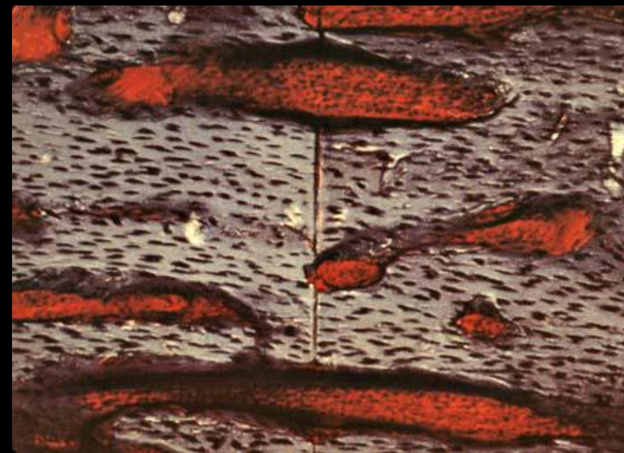


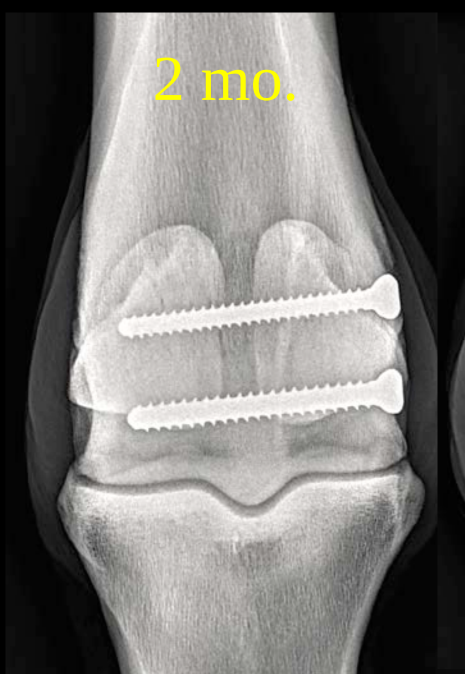


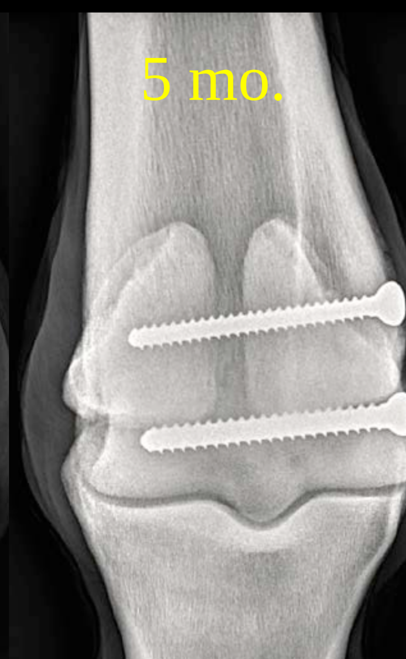


Sub-acute displaced condylar fracture

In periods of decreased stress osteoclasts turn on







So why is all this important?

- It goes to understanding why a horse gets lame.

Lameness is a sign not a disease

- The shifting of weight from one limb to another
- What causes lameness? pain (there are a few mechanical lameness)
- What causes pain, inflammation?
  - Tumor
  - Calor
  - Dolor
  - Rubor

What causes inflammation?

- Trauma
- Neoplasia
- Immune responses
- Degeneration
- Metabolic Disorders

- For practical purposes in the racehorse = trauma
  - Almost all fractures in the race horse are stress fractures
  - What are stress fractures? Fractures caused my multiple sub-maximal loads (cyclic stress)

Repetitive Cyclic Stress to the skeleton is the primary cause of lameness, and driver of skeletal modeling/remodeling

Relationship

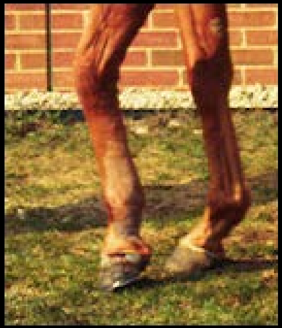
Am J Vet Res. 1996 Nov;57(11):1549-55.

High-speed exercise history and catastrophic racing fracture in thoroughbreds.

Estberg L, Stover SM, Gardner IA, Drake CM, Johnson B, Ardans A.

Load Stress = Magnitude X Frequency

- Why don’t all bones eventually fail
- Because the horse repairs them
- But there is a limit on the rate of repair and training can overwhelm the system



Am J Vet Res. 1996 Nov;57(11):1549-55.

Results:

…A horse that had accumulated a total of 35 furlongs of race and timed-work distance in 2 months, compared with a horse with 25 furlongs accumulated, had an estimated 3.9-fold increase in risk for racing-related FSI (95% confidence interval = 2.1, 7.1)…

All horses get the same diseases but the level of performance and the extreme ability of Thoroughbred racehorses magnifies skeletal effects

Why do racehorses have so much trouble with their musculo-skeletal system

- Wonderful cardio-vascular system
- The musculo-skeletal system is :
  - Slight to begin with
  - Requires the most training
  - Sustains the most wear and tear

- The skeleton has to be literally molded into a performance skeleton
- How do you do this?
  - Selective breeding and exercise

    (skeletal modeling)
  - Adaptive training

    (skeletal modeling and re-modeling)

Skeletal remodeling is work specific

Why does the skeleton require so much training?

Wolff's Law

- "Bone is laid down where strength is needed and removed where strength is unnecessary."
- Horses carry this to the extreme

Wolff’s Law

- Joint surfaces such as the distal cannon bone can’t change their size because they are within the joint
- They must change their structure

How many loads are required to train bone?

- Additional cycles become detrimental to bone
- We gallop too much and don’t vary gaits enough

- 36 cycles /day
- Bone trains to the level of work, not the amount
- Not true of cardiovascular system
  - Interval training revolutionized human training

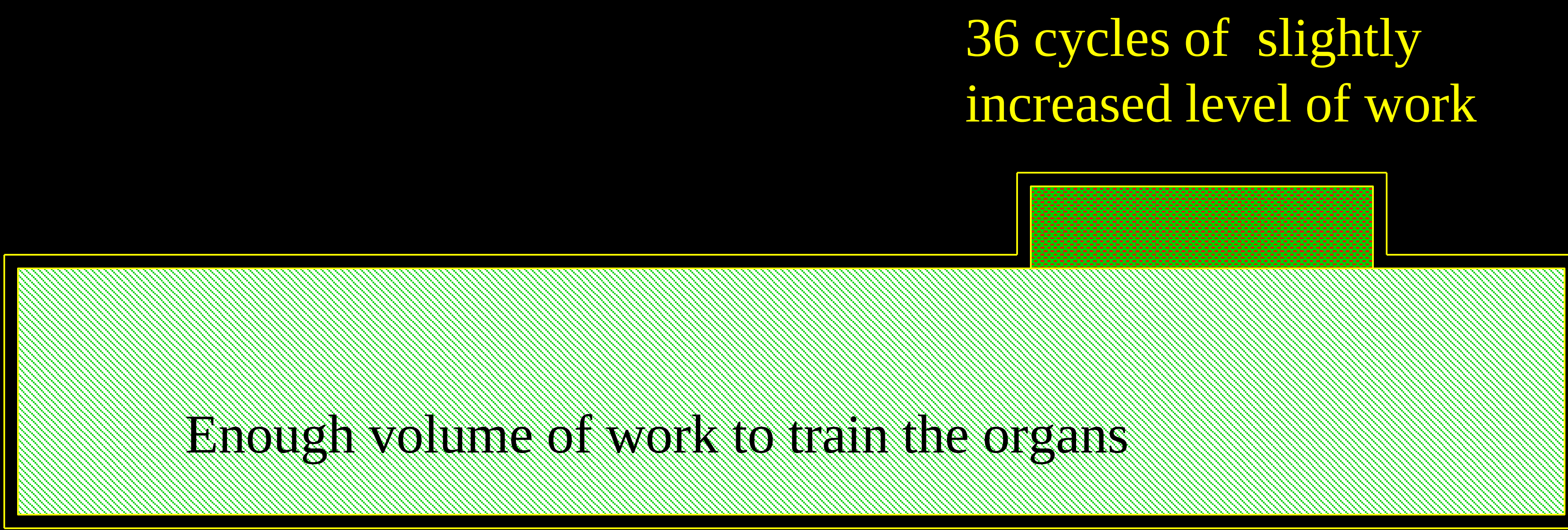
Regulation of bone formation by applied dynamic loads
CT Rubin and LE Lanyon
The Journal of Bone and Joint Surgery, Vol 66, Issue 3 397-402

The highest load 36 cycles / day guide the bone response

- A little better than a furlong
- The rest is trauma
- Lots of implications for training
  - Galloping a horse lots of miles doesn’t strengthen the bone, it weakens it
  - One furlong should be a little faster than the rest

Furlong = 660’
Secretariat 25’ stride
= 26 cycles / Furlong

The ideal training session for bone



Effective Training

- Balances the work and the response
- This is the essence of being a trainer

Training Becomes a Balancing Act

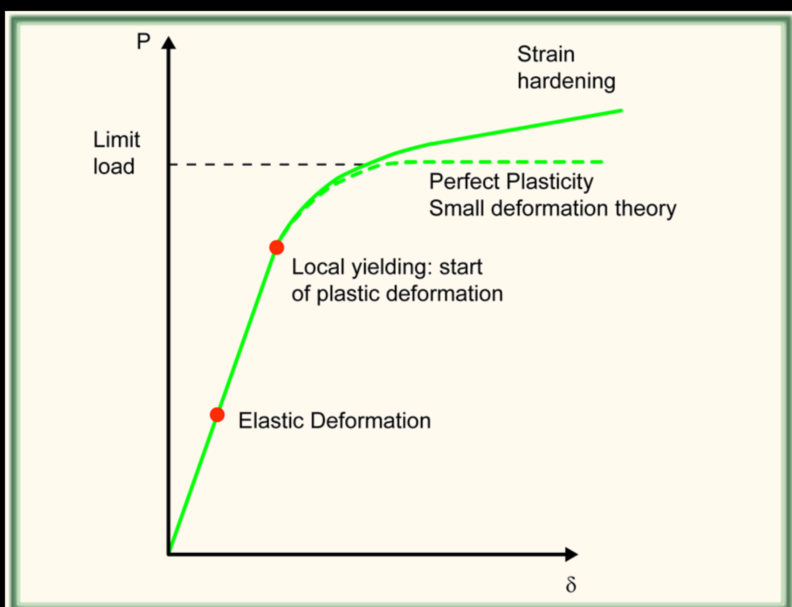
- Enough work to train the organs
- Not so much work to overload the skeleton with the cyclic fatigue

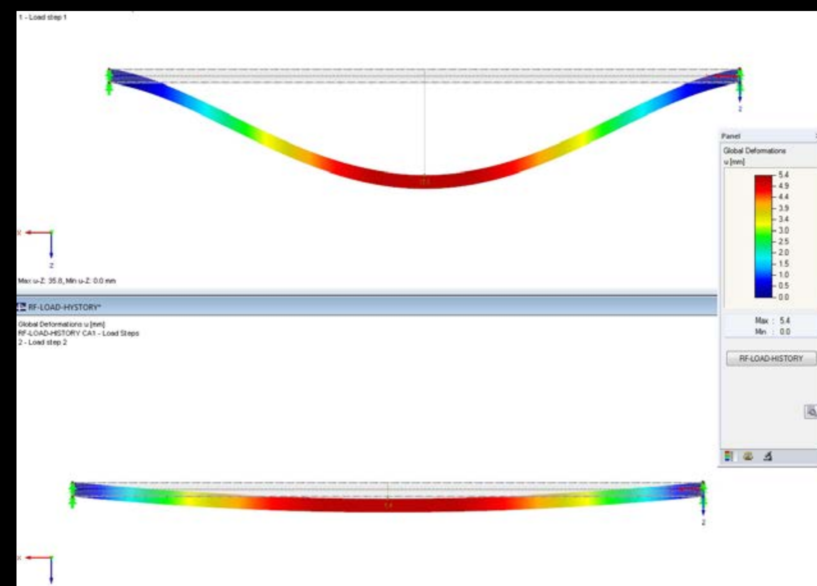
What happens if we get too much volume of work

- Cyclic Fatigue
- Structural damage
- Structural Failure

Cyclic Fatigue of Material

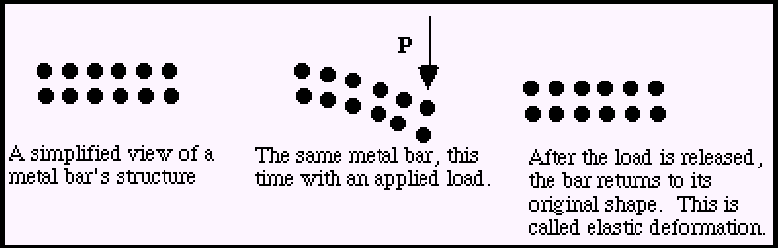
- Elastic Deformity
- Plastic Deformity

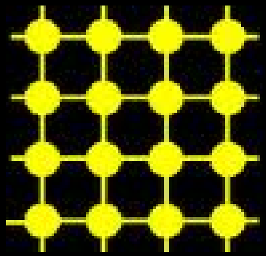


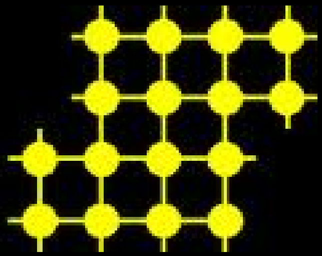


Biologic Materials

- Biologic Materials never reach elastic properties
- But, they have the capacity to heal/repair when damaged







Which is more stressful on a horse's bone?

Race Training

Rate of Repetitive Loading is Important to Crystalline Structures

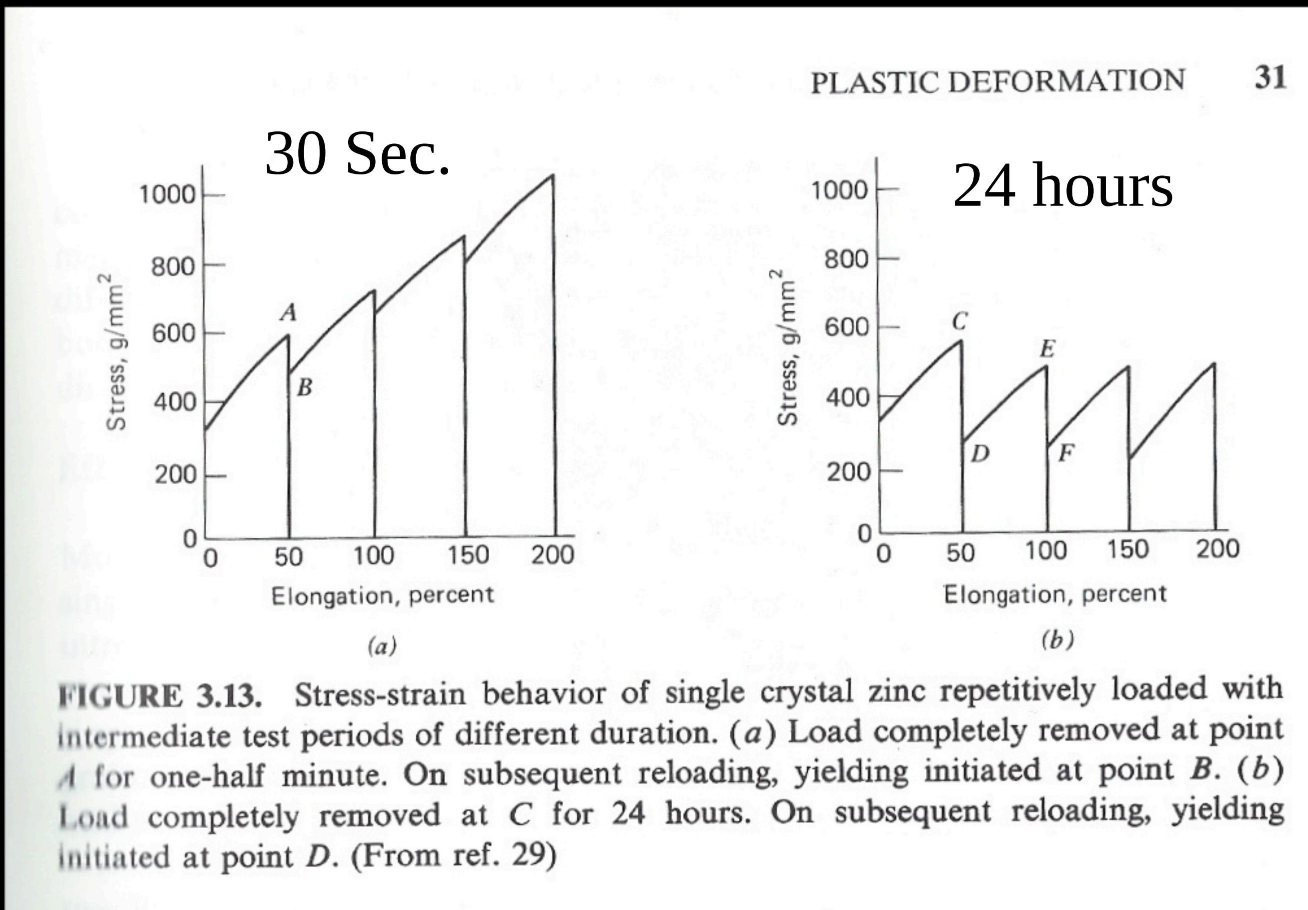
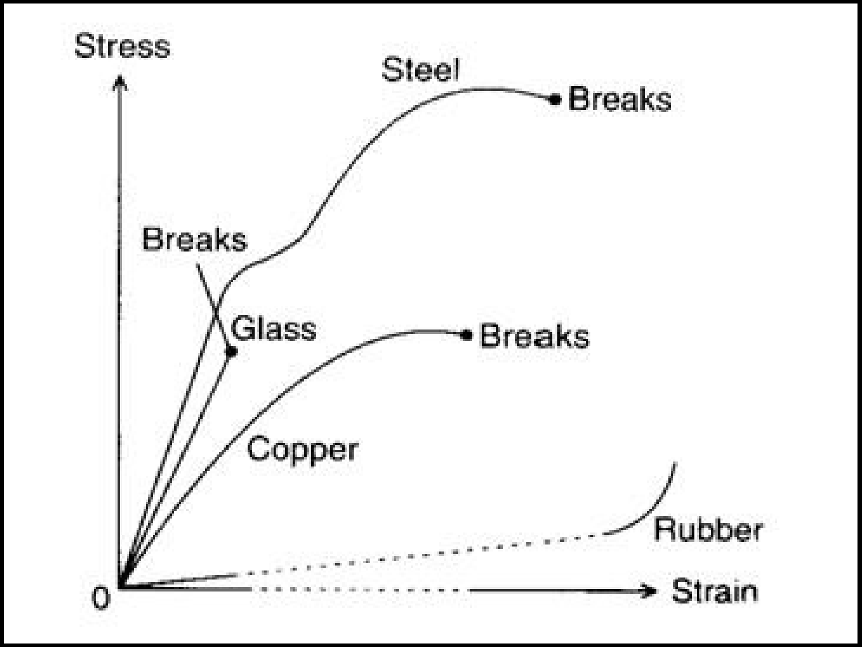


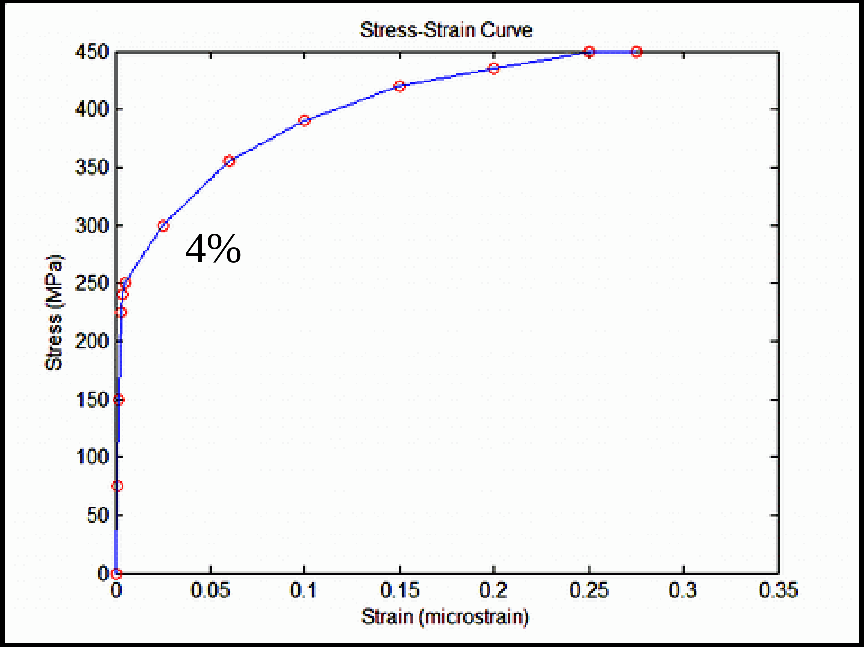
FIGURE 3.13. Stress-strain behavior of single crystal zinc repetitively loaded with intermediate test periods of different duration. (*a*) Load completely removed at point *A* for one-half minute. On subsequent reloading, yielding initiated at point *B*. (*b*) Load completely removed at *C* for 24 hours. On subsequent reloading, yielding initiated at point *D*. (From ref. 29)

High Speed Cyclic Loading results in a debt that needs to heal

Failure of Materials in Mechanical Design, J.A. Collins

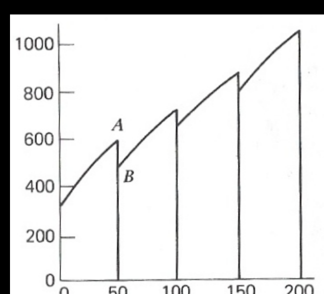
Bone has little elasticity

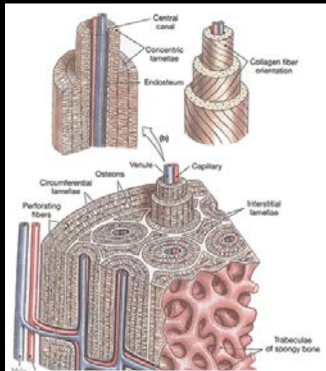




Repair

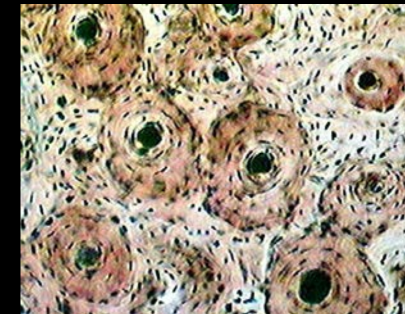
- Overload Results in Over repair
- This process results in increased capacity
- This is the basis of training

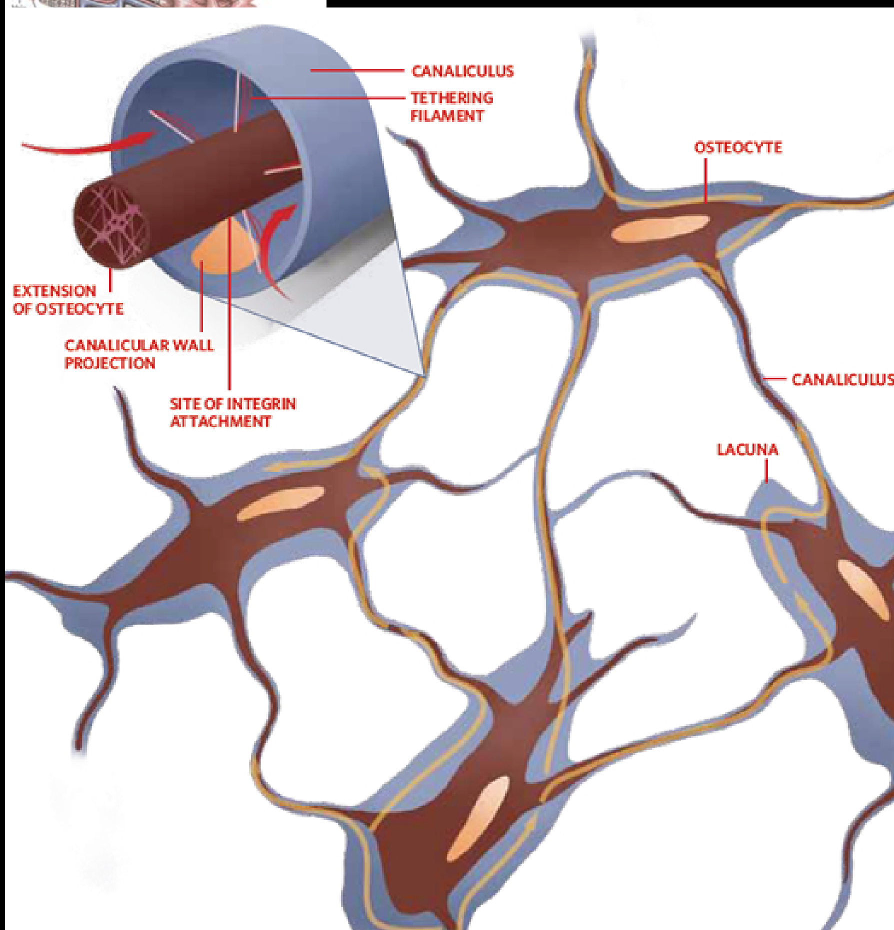




Director!

The Osteocyte detects the mechanical loading





Canaliculi
are the key

How Bone trains

Overload results in micro-fracture generation

Racing

Over repair results In hypertrophy

Over repair
overload
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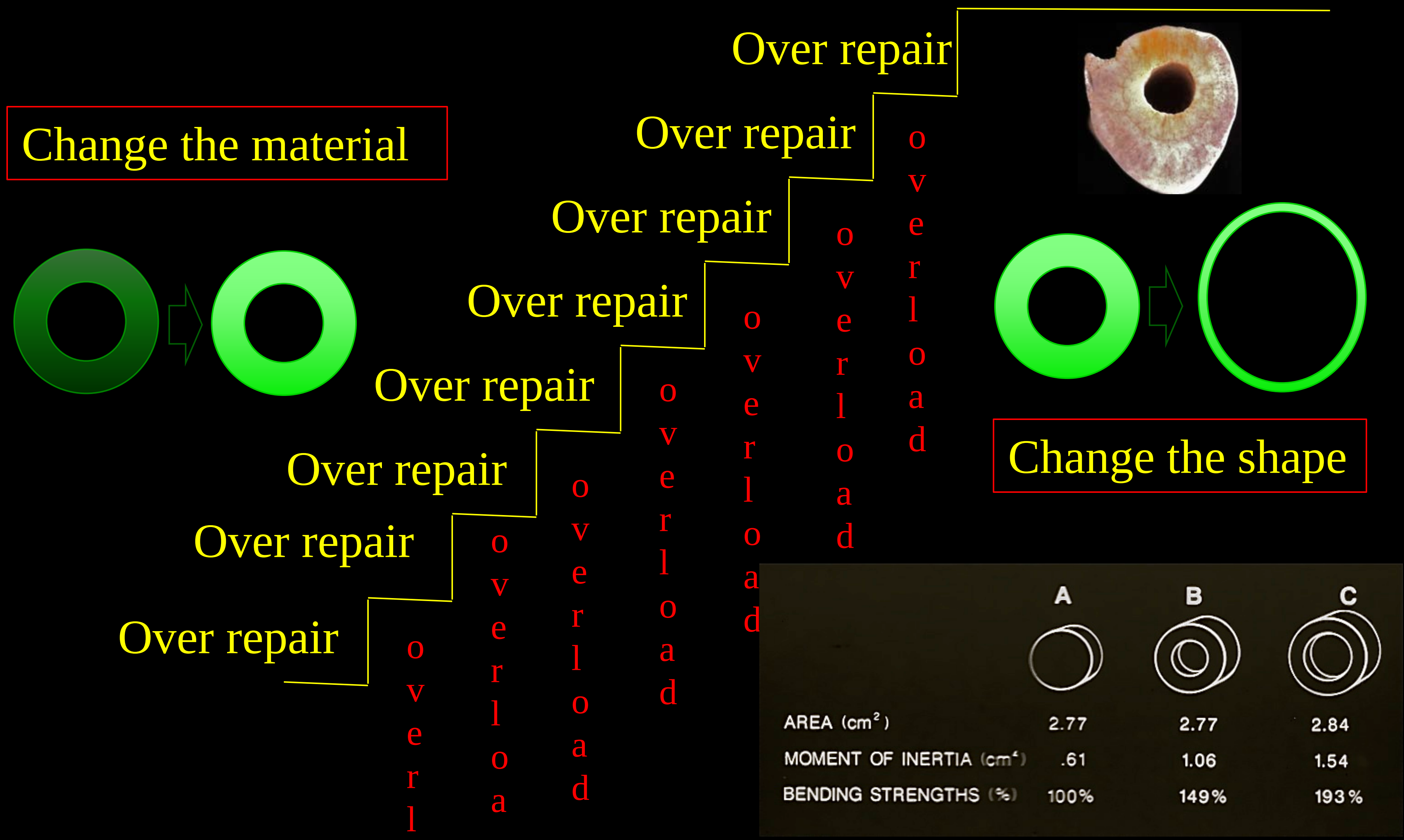
How bone responds



Nunamaker 2002 Milne Lecture

MILNE LECTURE: EQUINE ORTHOPEDICS

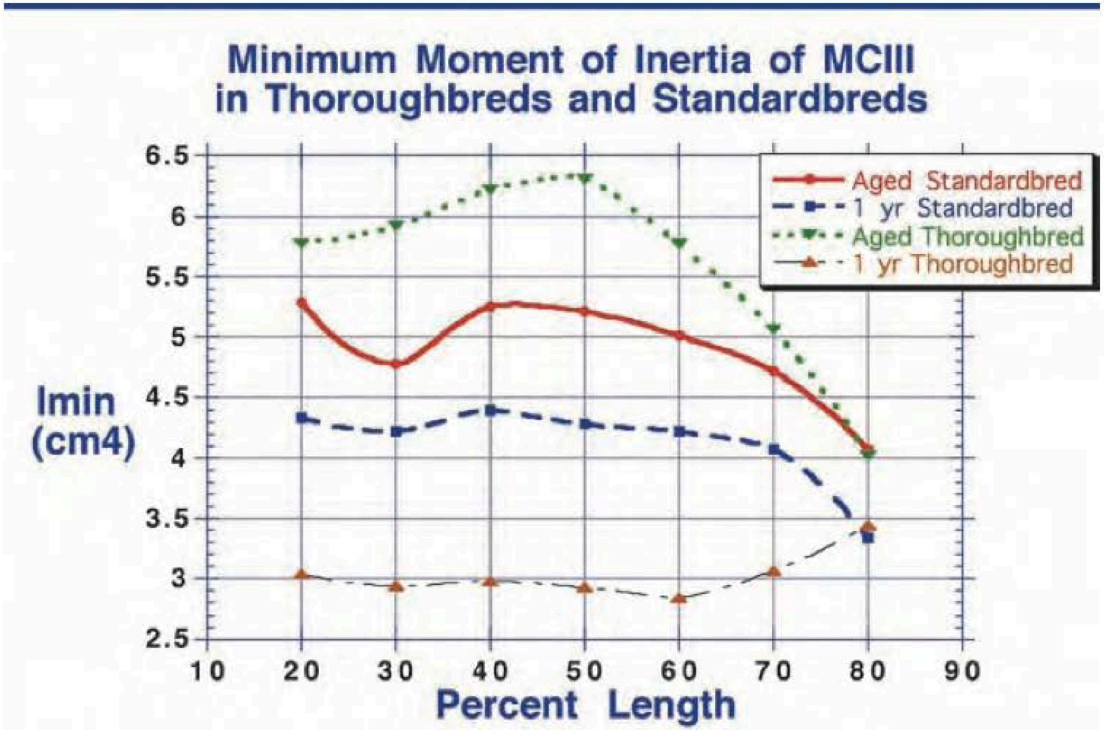
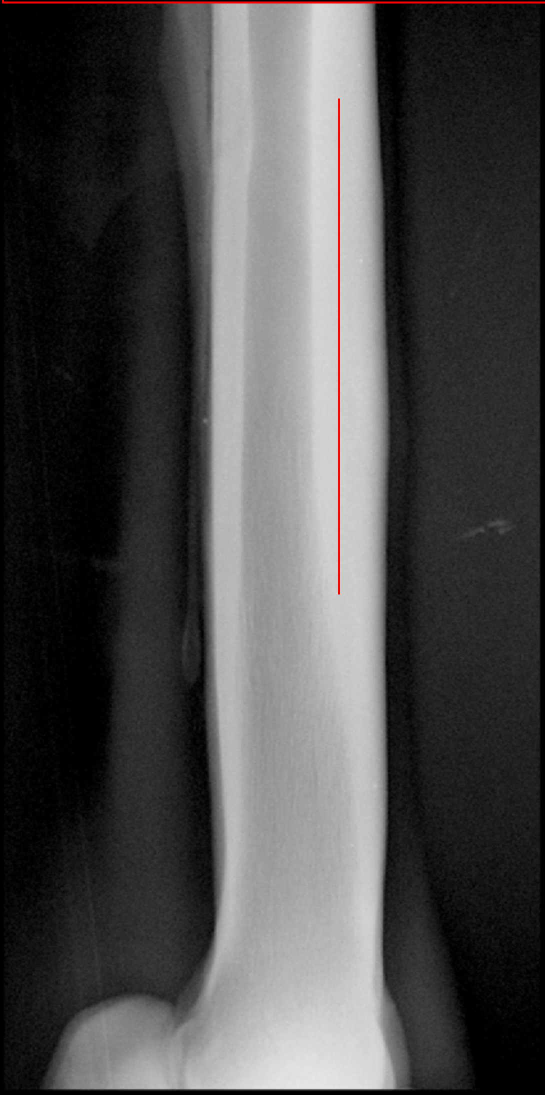


Fig. 4. Graphical representation of MCIII inertial properties relating to dorsopalmar bending of the MCIII is demonstrated by breed and age. It can be noted that the Thoroughbred racehorse increases its I_{min} to a much greater extent than does the Standardbred racehorse. Horses would seem to be at risk for bucked shins during this change in shape.

Adaptation necessary to accommodate to the high stress of repetitive cyclic load

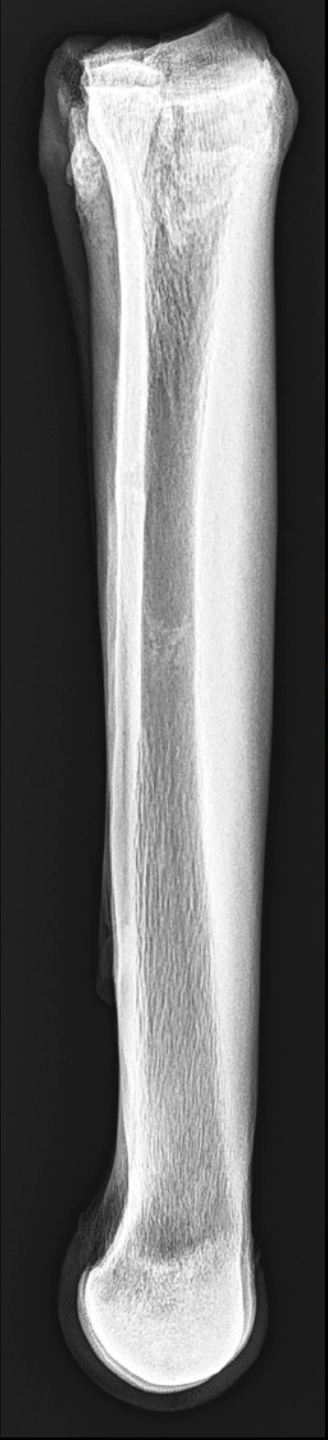
- Horses are not born with racehorse skeletons; they are made by training
- Dorsal cannon bone hypertrophies to twice its yearling diameter
- Caudal Tibia almost doubles in thickness
- Other sites must similarly adapt

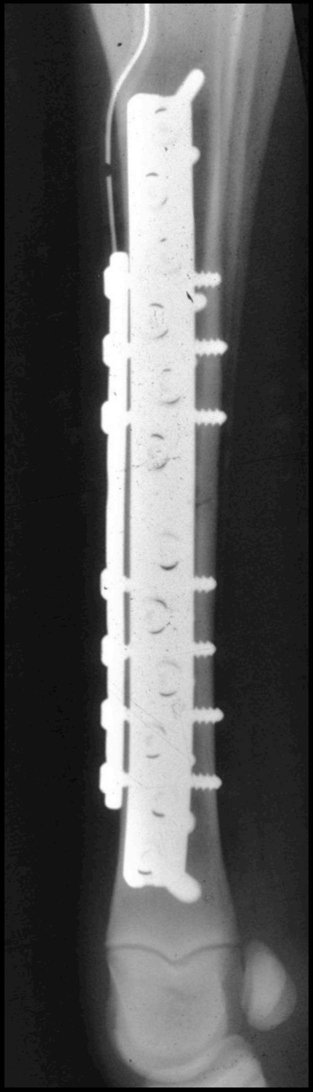
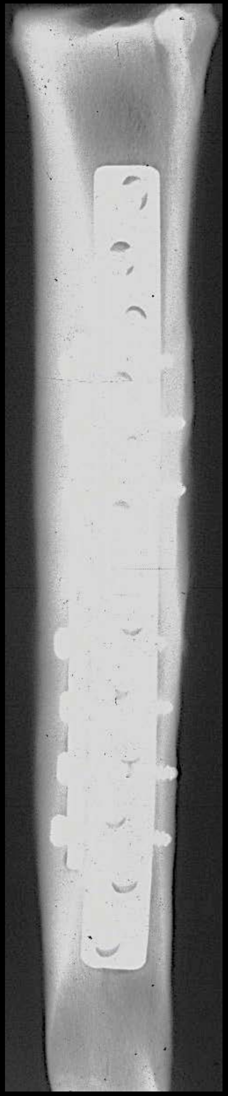
Adaptation necessary to accommodate to the high stress of repetitive cyclic load



- Dorsal cannon bone hypertrophies to twice it's yearling diameter
- Caudal Tibia almost doubles in thickness
- Other sites must similarly adapt
- Usually it does both increase its density and change its shape

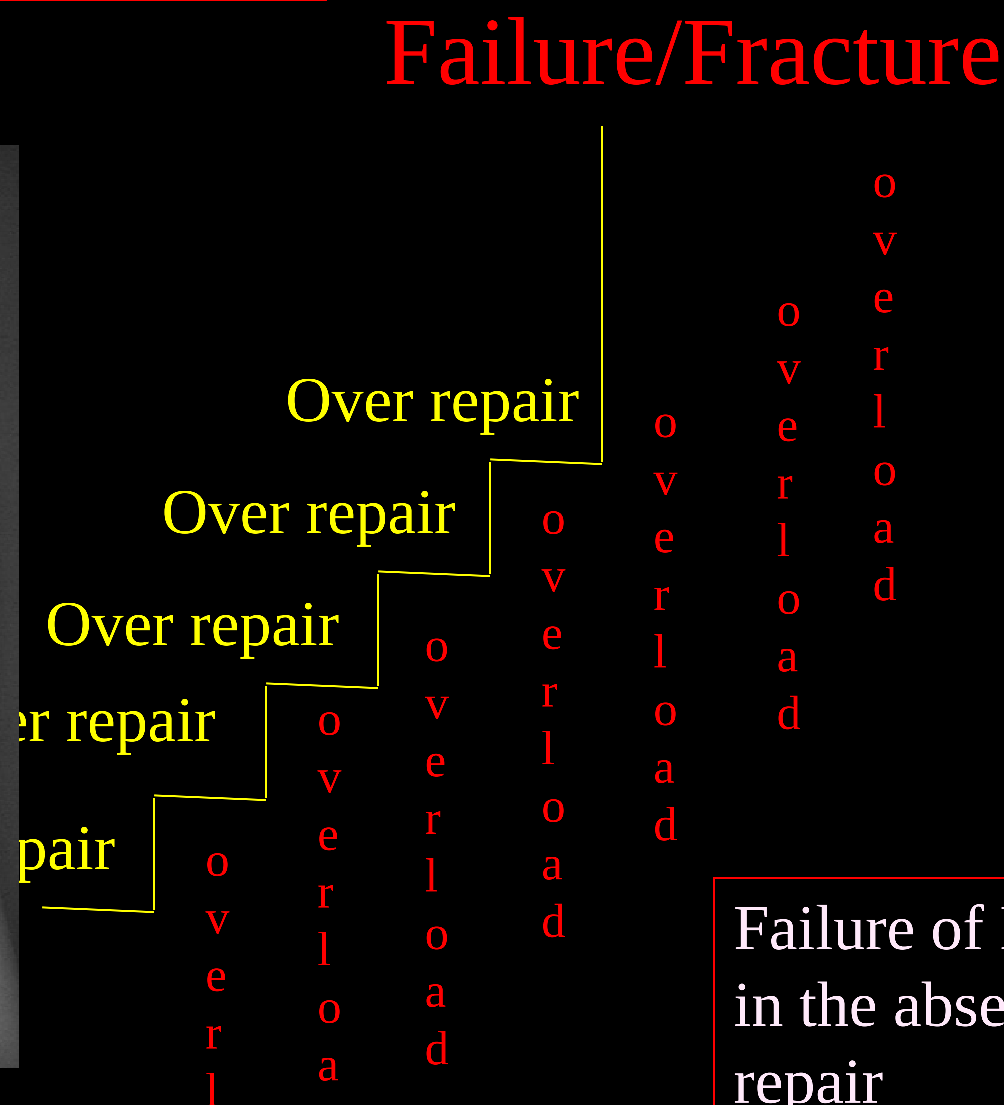
Mechanics dictate!




How Bone trains

Overload results in micro-fracture generation



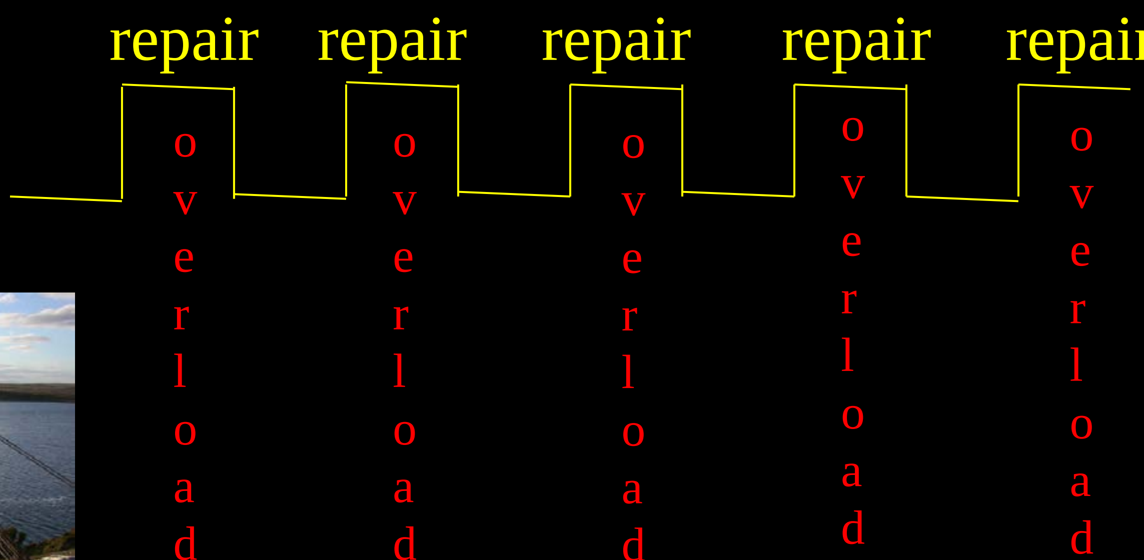
Failure of Bone occurs in the absence of adequate repair

How Bone Maintains

Overload results in micro-fracture generation

- High speed furlongs result in bone damage that must be healed.
- Biologic systems remain plastic, never gain elastic status.

Racing



How Bone Maintains

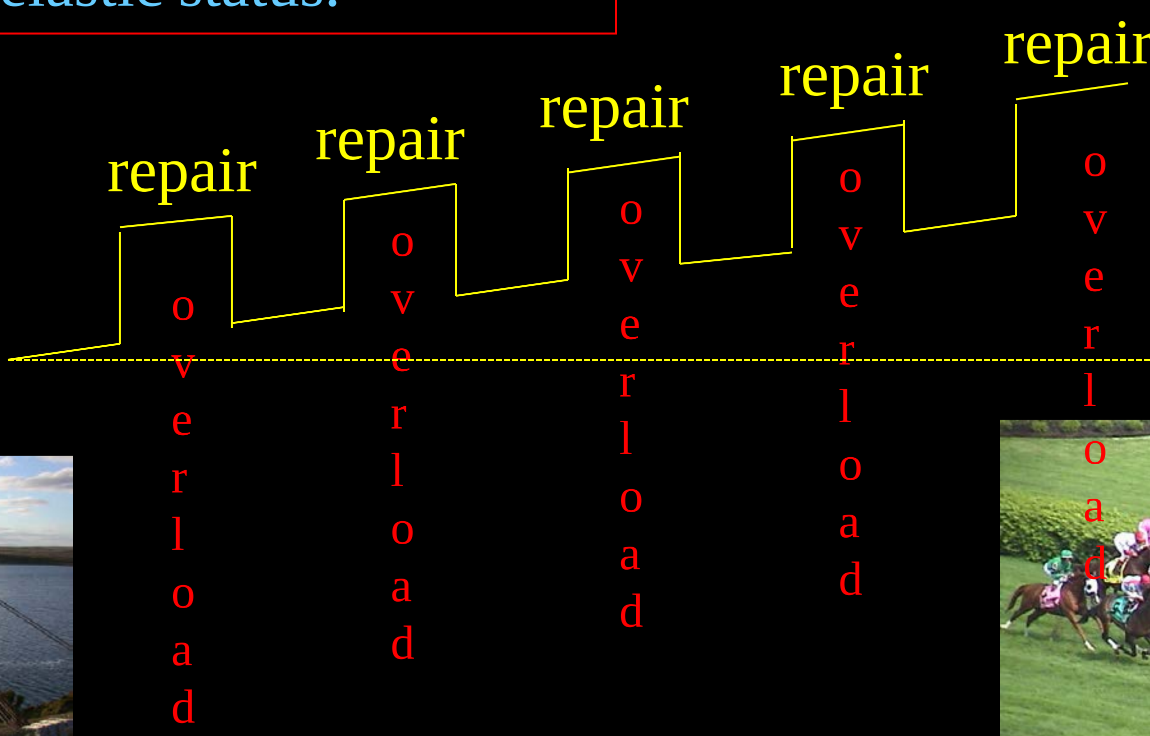
Overload results in micro-fracture generation, secondary remodeling is largely turned off.

- High speed furlongs result in bone damage that must be healed.
- Biologic systems remain plastic, never gain elastic status.

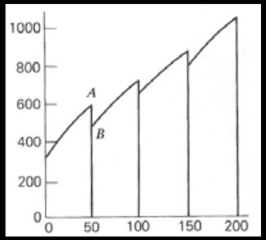
In Reality

Am J Vet Res. 1996 Nov;57(11):1549-55.

Racing



Debt



Metacarpus III

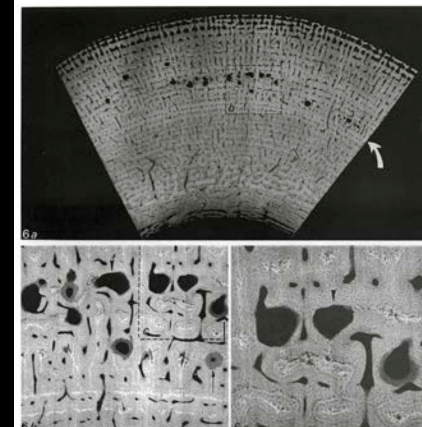
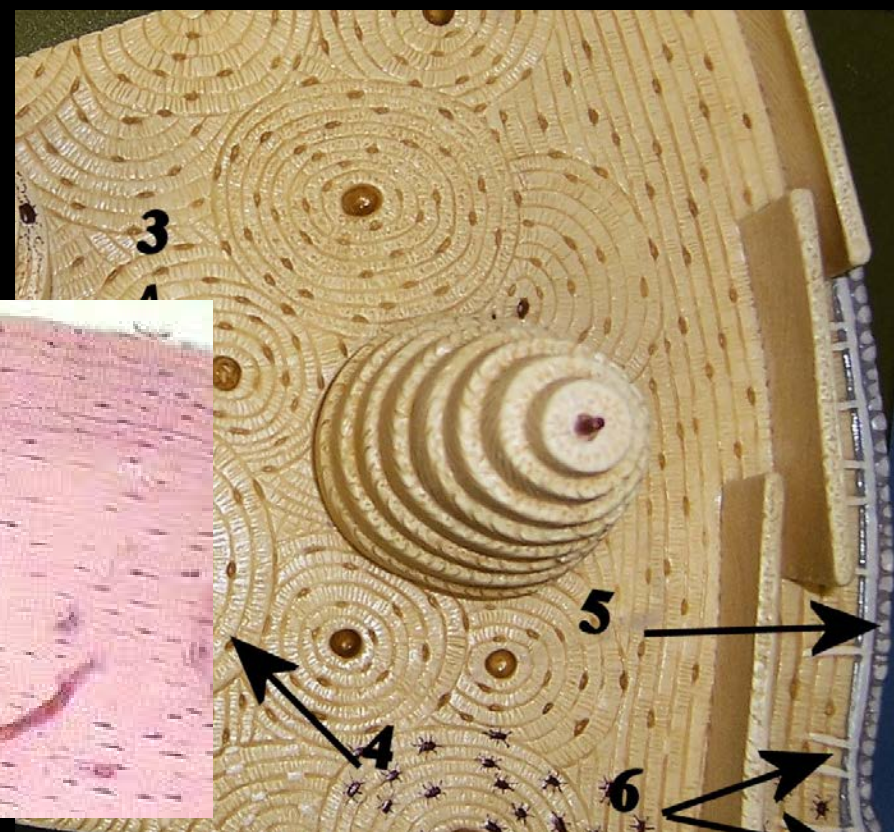


Fig. 6. Photomicroradiographs of the lateral section of a 145-d-old male. (a) Bone apposition has occurred on the outer and inner cortical surfaces. The junction (white arrow) of postnatal and prenatal bone is deeper within the cortex than in the younger foal (Fig. 2a). Resorption cavities associated with initial stages of bone remodelling are located only in postnatal bone. Bar, 1000 µm. (b) Enlarged region outlined in Figure 6a. Resorption cavities (arrowhead) and forming secondary osteons (arrow) are limited to the areas of woven-fibred bone. Bar, 200 µm. (c) Enlarged region outlined in Fig. 6b. Osteoclasts have resorbed woven-fibred bone and spared the surrounding primary osteons to yield a triangular-shaped resorption cavity (arrowhead). Bar, 200 µm.



J. Anat. (1992) **181**, pp. 455–469, with 16 figures Printed in Great Britain

Histological features of the dorsal cortex of the third metacarpal bone mid-diaphysis during postnatal growth in thoroughbred horses

SUSAN M. STOVER[1], ROY R. POOL[2], R. BRUCE MARTIN[3] AND JOE P. MORGAN[4]

Veterinary Orthopedic Research Laboratory, Departments of [1] Veterinary Anatomy and Cell Biology, [2] Pathology, and [4] Radiological Sciences, School of Veterinary Medicine; and the [3] Orthopedic Research Laboratories, Department of Orthopedic Surgery, School of Medicine, University of California

(*Accepted 16 September 1992*)

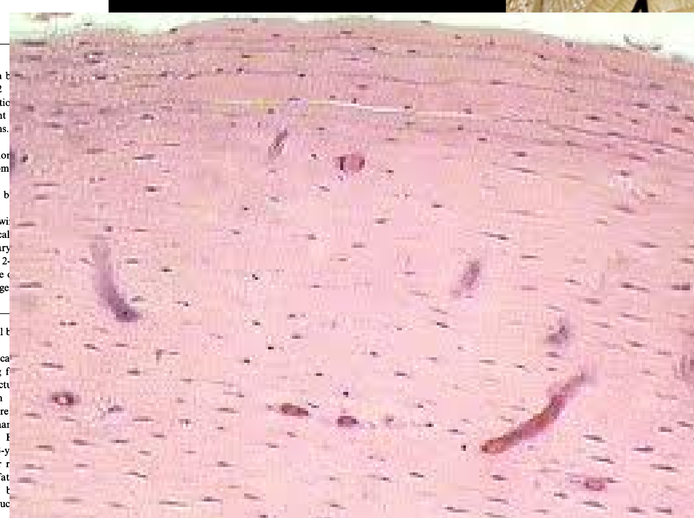
ABSTRACT

The dorsal cortex of the equine third metacarpal mid-diaphyseal bone was characterised during growth b the histological and microradiographic examination of specimens from 30 horses ranging in age from 2 months to 8 y. Bone from horses aged less than 6 months was characterised by rapid periosteal appositic of circumferential trabeculae of woven bone that were next connected by radial trabeculae to the parent cortex. Deposition of lamellar bone on the inner trabecular surfaces resulted in rows of primary osteons. Replacement of primary bone occurred only after 4 months of age and preferentially in the woven interstitial bone separating rows of primary osteons formed in the postnatal periosteal cortex. Resorptior cavities and incompletely filled secondary osteons characterised bone of 1 and 2-y-old horses. Bone from horses older than 3 y contained several generations of secondary osteons, fewer resorption spaces and incompletely filled osteons, and had a greater portion of circumferentially oriented collagen fibres than b from younger horses. Bone from horses older than 5 y had large resorption cavities characterised by irregular boundaries. We propose that the process of periosteal bone tissue apposition observed in growi foals be called 'saltatory primary osteonal bone formation' and that this process results in faster cortical expansion and larger total surface area for bone deposition than circumferential lamellar, simple primary osteonal, and plexiform mechanisms of periosteal bone formation. We speculate that bone from 1 and 2- old horses would be more susceptible to fatigue microdamage resulting from compressive loads because high porosity, few completed secondary osteons and low proportion of circumferentially oriented collage fibres.

INTRODUCTION

Structural variations in the microscopic organisation of bone tissue in bone organs occur in a manner consistent with growth and remodelling processes for each animal species (Enlow, 1966). During life, a bone organ is affected by 2 general processes: changes in size and shape, and remodelling of the internal architecture. Bone deposition, resorption and remodelling produce changes in the amount, mineralisation and type of bone tissue present in the bone organ (Carter & Spengler, 1978). These changes affect the mechanical properties of bone tissue and ultimately of the bone organ (Currey, 1959; Lipson & Katz, 1984), as well as the fatigue life of cortical b (Carter & Hayes, 1976).

The dorsal cortex of the equine third metaca bone is subject to 2 major disorders resulting f racing activities, 'bucked shins' and stress fractu that together affect over 70% of horses in training (Norwood, 1978). These disorders are lieved to result from cyclic loading and mechar fatigue damage (Nunamaker et al. 1990). disorders are found predominantly in 2 and 3-y racehorses, and much less commonly in older r horses (Copelan, 1979). Since the strength and fat resistance of cortical bone are related to b microstructure, and since bone microstruc



Correspondence to Dr Susan M. Stover, Department of Veterinary Anatomy and Cell Biology, School of Veterinary Medicine, Univ of California, Davis, CA 95616, USA.

Metacarpus III

Resorption cavities?
Unmineralized
Osteons, All aligned with primary osteons
Secondary osteons?

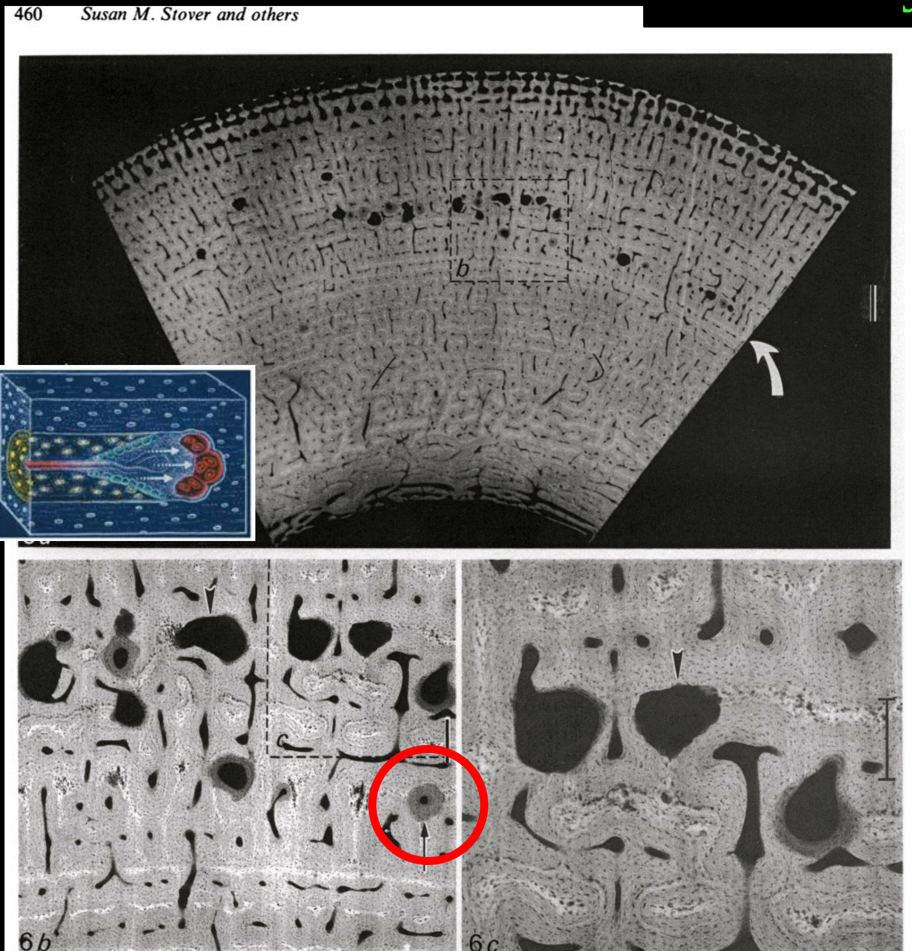
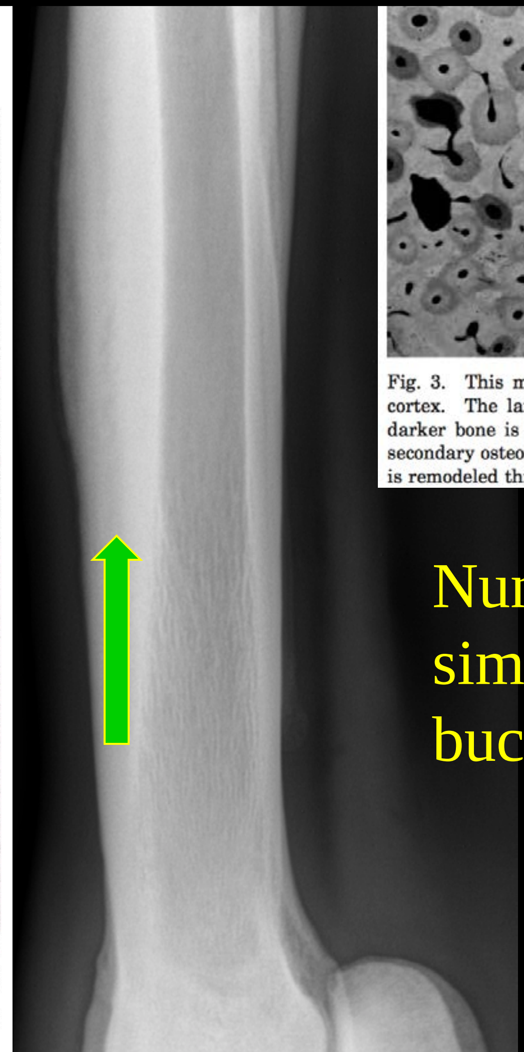


Fig. 6. Photomicroradiographs of the lateral section of a 145-d-old male. (*a*) Bone apposition has occurred on the outer and inner cortical surfaces. The junction (white arrow) of postnatal and prenatal bone is deeper within the cortex than in the younger foal (Fig. 2*a*). Resorption cavities associated with initial stages of bone remodelling are located only in postnatal bone. Bar, 1000 µm. (*b*) Enlarged region outlined in Figure 6*a*. Resorption cavities (arrowhead) and forming secondary osteons (arrow) are limited to the areas of woven-fibred bone. Bar, 200 µm. (*c*) Enlarged region outlined in Fig. 6*b*. Osteoclasts have resorbed woven-fibred bone and spared the surrounding primary osteons to yield a triangular-shaped resorption cavity (arrowhead). Bar, 200 µm.



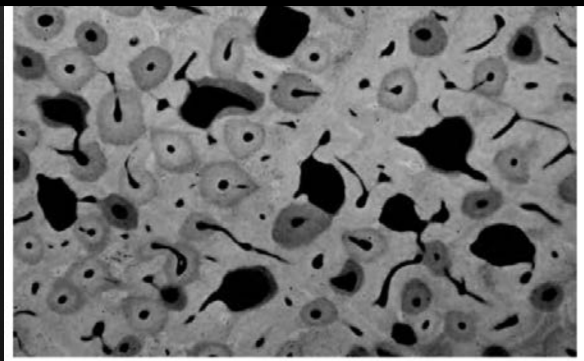
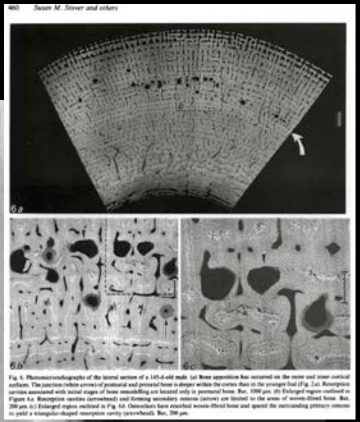


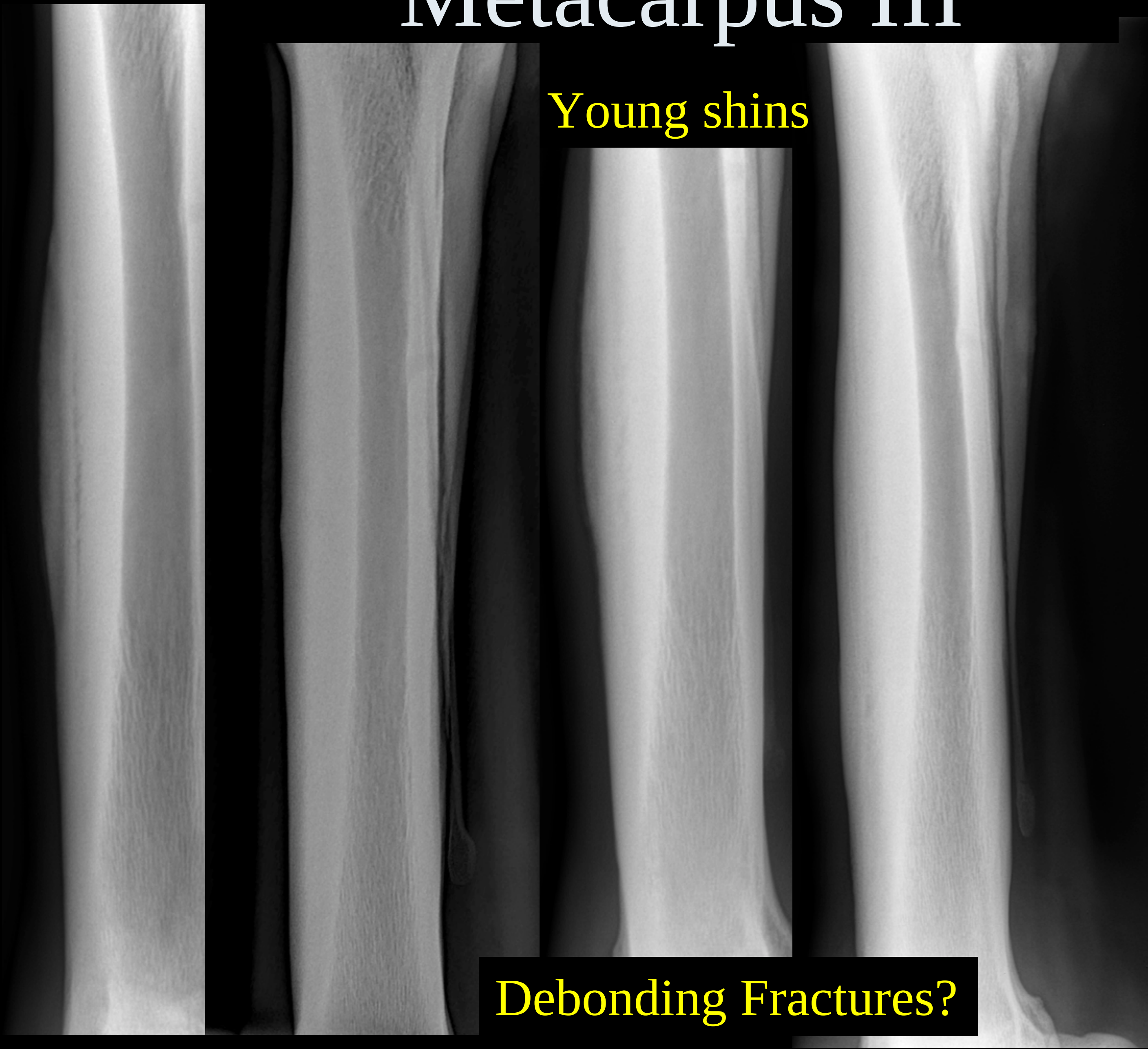
Fig. 3. This microradiograph shows the horse remodeling its cortex. The large black holes are resorption cavities and the darker bone is the new less calcified bone that makes up the secondary osteons. It is evident from this section that the bone is remodeled throughout its cortex and is a dynamic structure.

Nunamaker found similar cavities in bucked shins, AAEP 2002

Metacarpus III



Young shins



Debonding Fractures?

One reason to train two year olds.

Metacarpus III

Cyclic Fatigue

- Results in work specific damage

Evidence

- We always train left handed
- This forces training on the left lead in the turns
- Is there evidence for structural overload from this practice?

Perhaps

- Condylar Fracture

Development of a Condylar Fracture

- Exercise induced
- Accumulation of stress in excess of repair initiates
- Propagation depends on the amount of stress post - occurrence

Equine Veterinary Journal

Results of treatment of 145 fractures of the third metacarpal/metatarsal condyles in 135 horses (1986–1994)

L J. ZEKAS, L. R. BRAMLAGE, R. M. EMBERTSON, S. R. HANCE

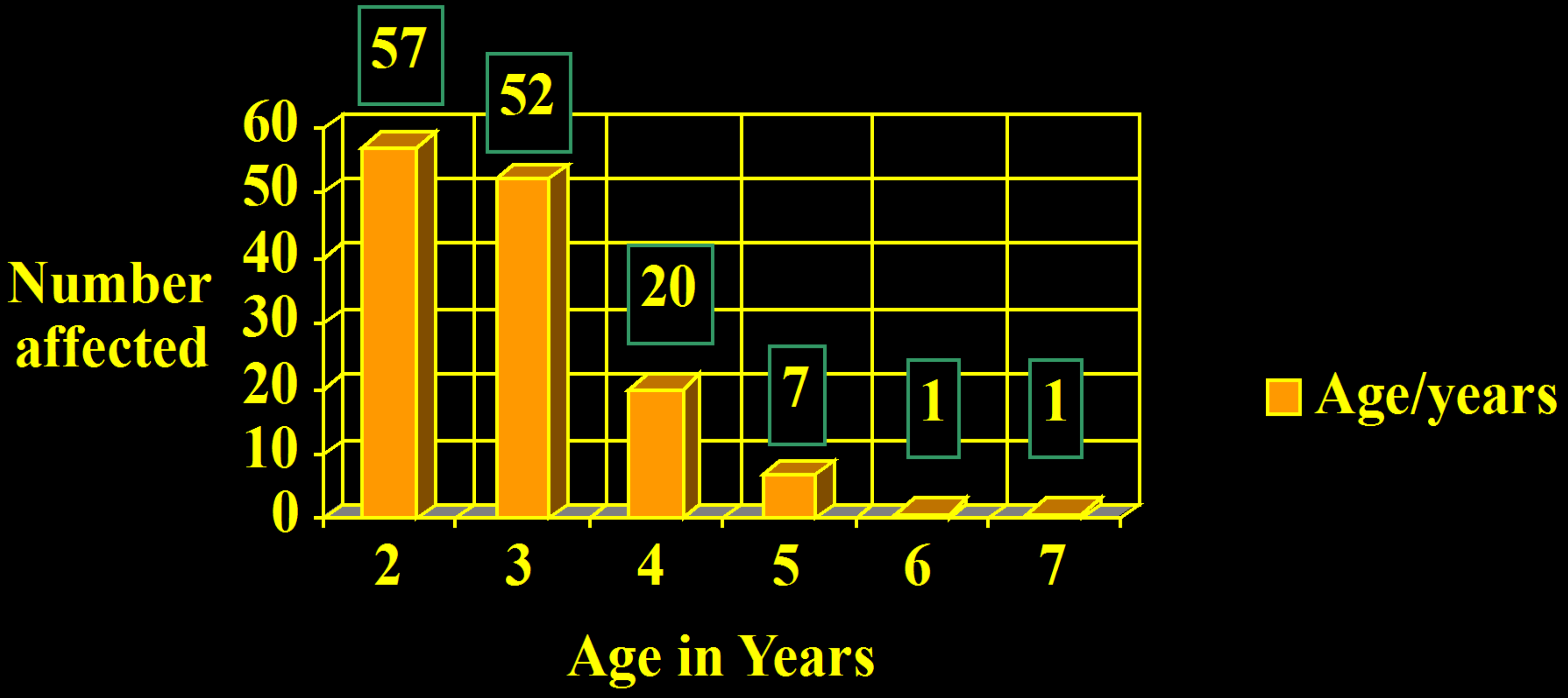
Equine Vet J
31 (4):309–313(1999)

Characterisation of the type and location of fractures of the third metacarpal/metatarsal condyles in 135 horses in central Kentucky (1986-1994).

L J Zekas, L R Bramlage, S R Hance.

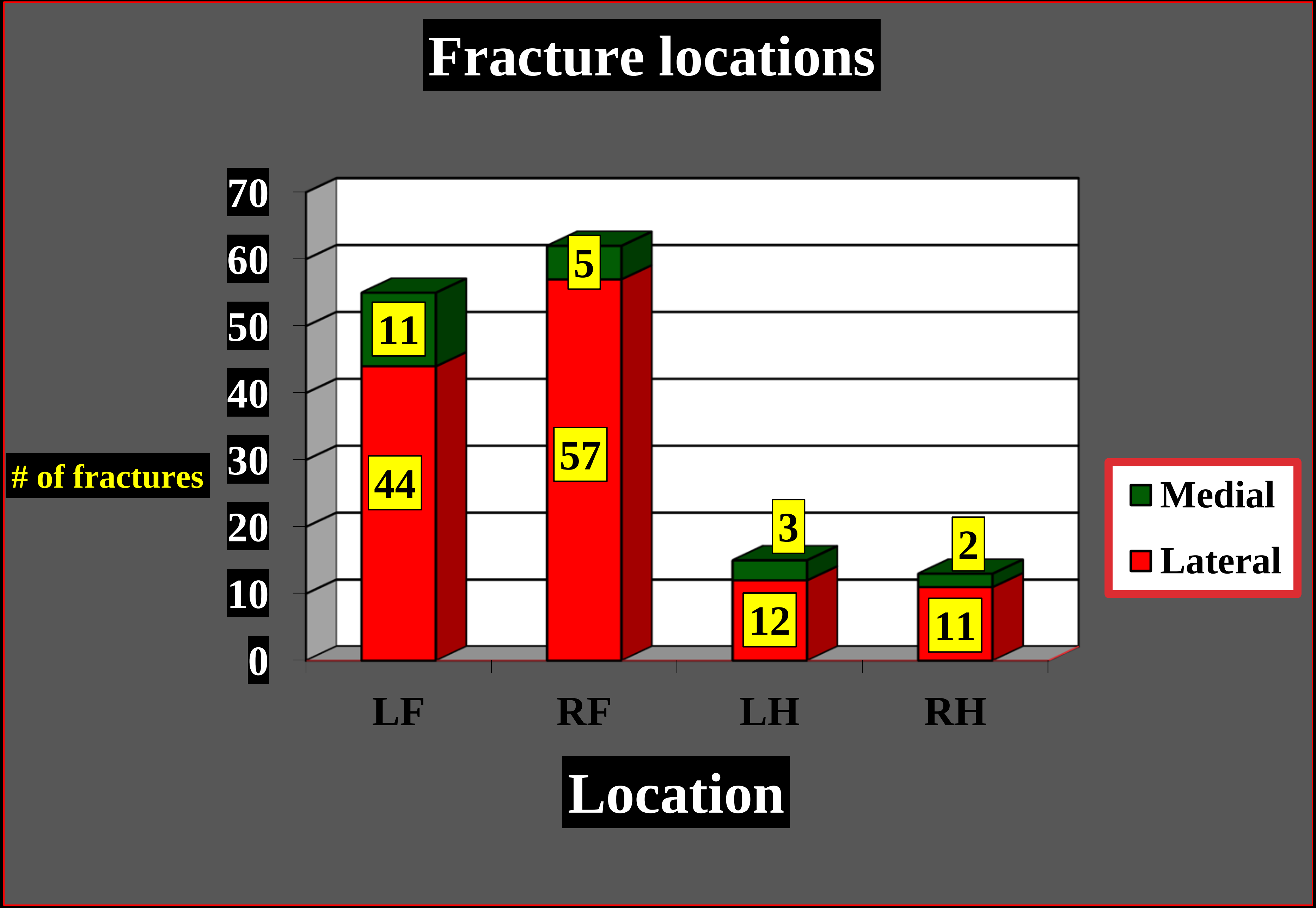
Equine Vet J
31(4):304-8 (1999)

Age of Horses with Condylar Fractures



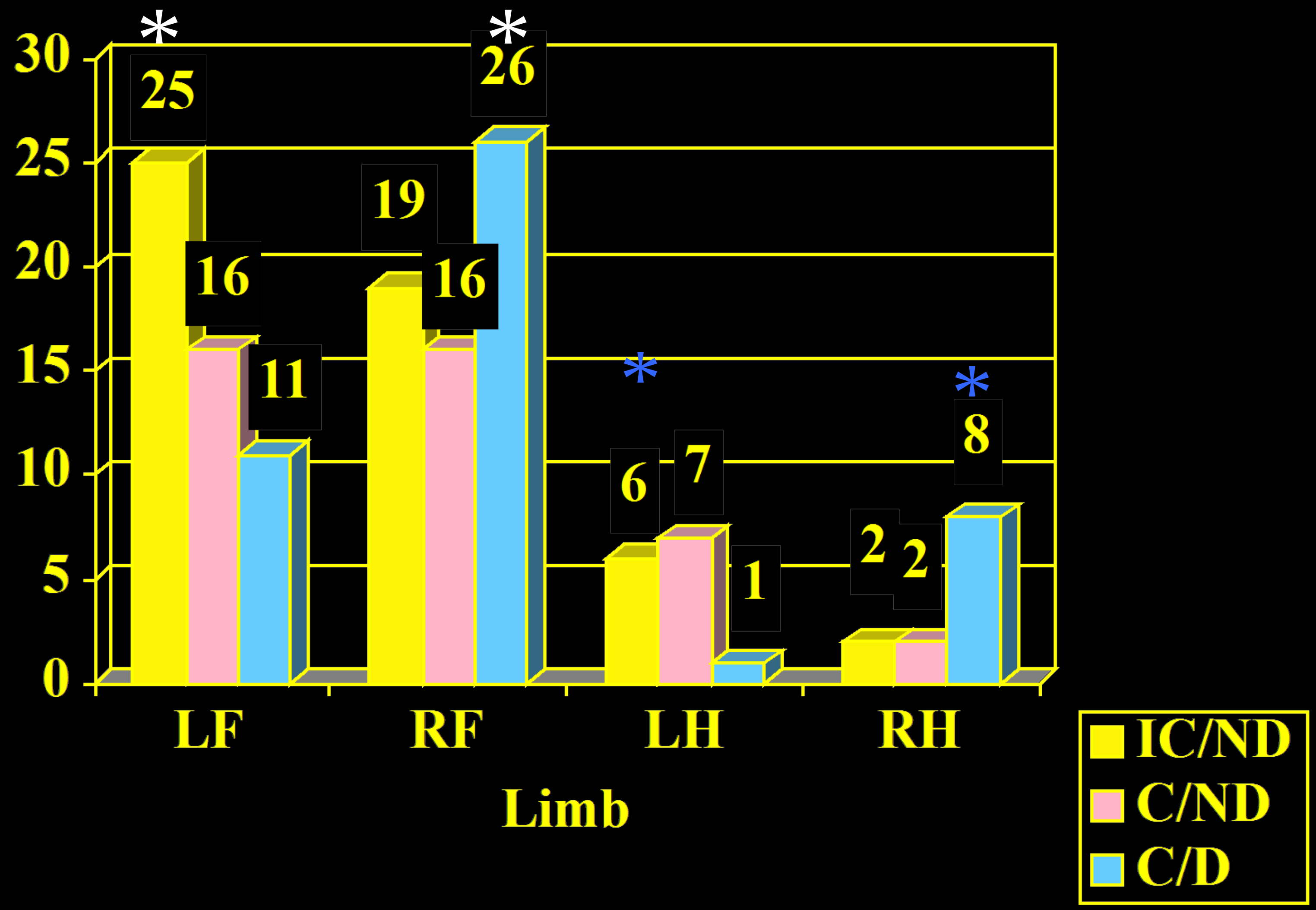
N=145 fractures in 135 horses

Plus 20 Spiraling Fractures



Fracture locations
70
60
50
40
30
20
10
0
# of fractures
11
44
5
57
3
12
2
11
LF
RF
LH
RH
Medial
Lateral
Location

Fracture Configuration/Distribution



England

Catastrophic fracture of the lateral condyle of the third metacarpus/metatarsus in UK racehorses – fracture descriptions and pre-existing pathology

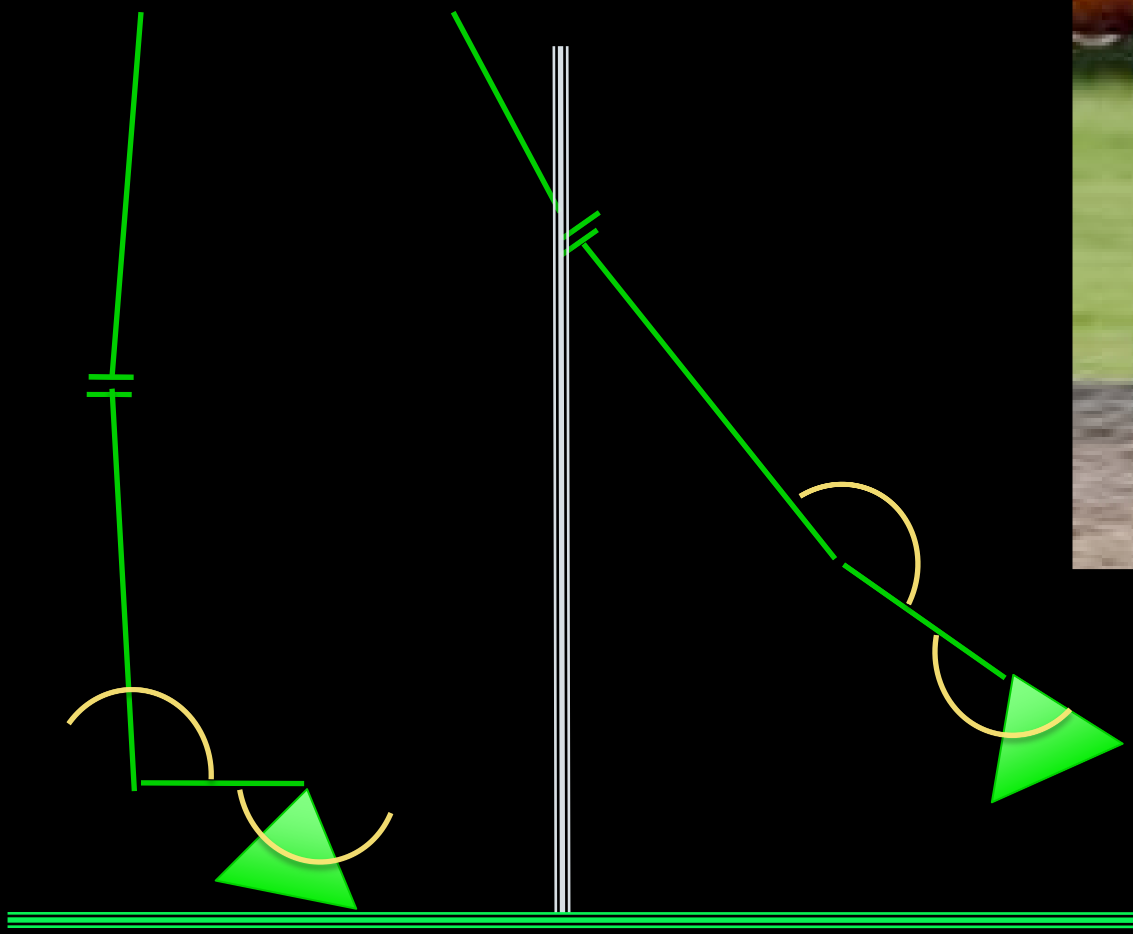
T.D.H. Parkin P.D. Clegg, N.P. French, C.J. Proudman, C.M. Riggs, E.R. Singer, P.M. Webbon, K.L. Morgan

The Veterinary Journal Volume 171, Issue 1, January 2006, Pages 157–165

Abstract

The characteristics of, and pre-existing pathology associated with 75 cases of fatal lateral condylar fracture sustained by Thoroughbreds while racing in the UK were described. Cases were identified from 220 cases of fatal distal limb fracture submitted as part of studies designed to identify risk factors for all fatal distal limb fractures. Fractures were most common in hurdle races and affected the right forelimb twice as often as the left forelimb. Fracture dimensions were similar to previous reports, however there was a much greater prevalence of articular and diaphyseal comminution and of concurrent fractures in the current report. Pre-existing pathology was particularly common in the medial and lateral parasagittal grooves of the distal articular surfaces of the third metacarpus/metatarsus. The degree of this pathology was not associated with horse age, length of career or number of career starts.

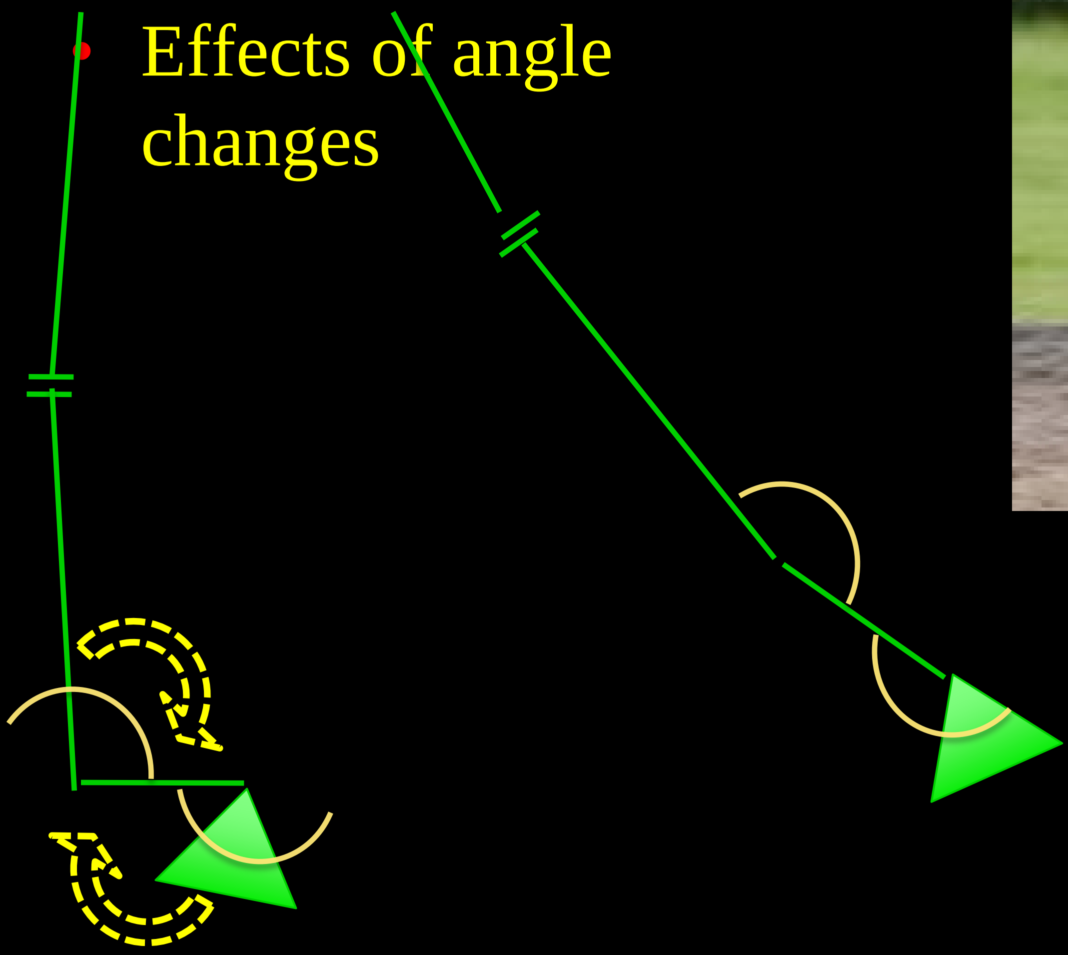
Man-made predilection to distal cannon bone injury



Shoeing appliances

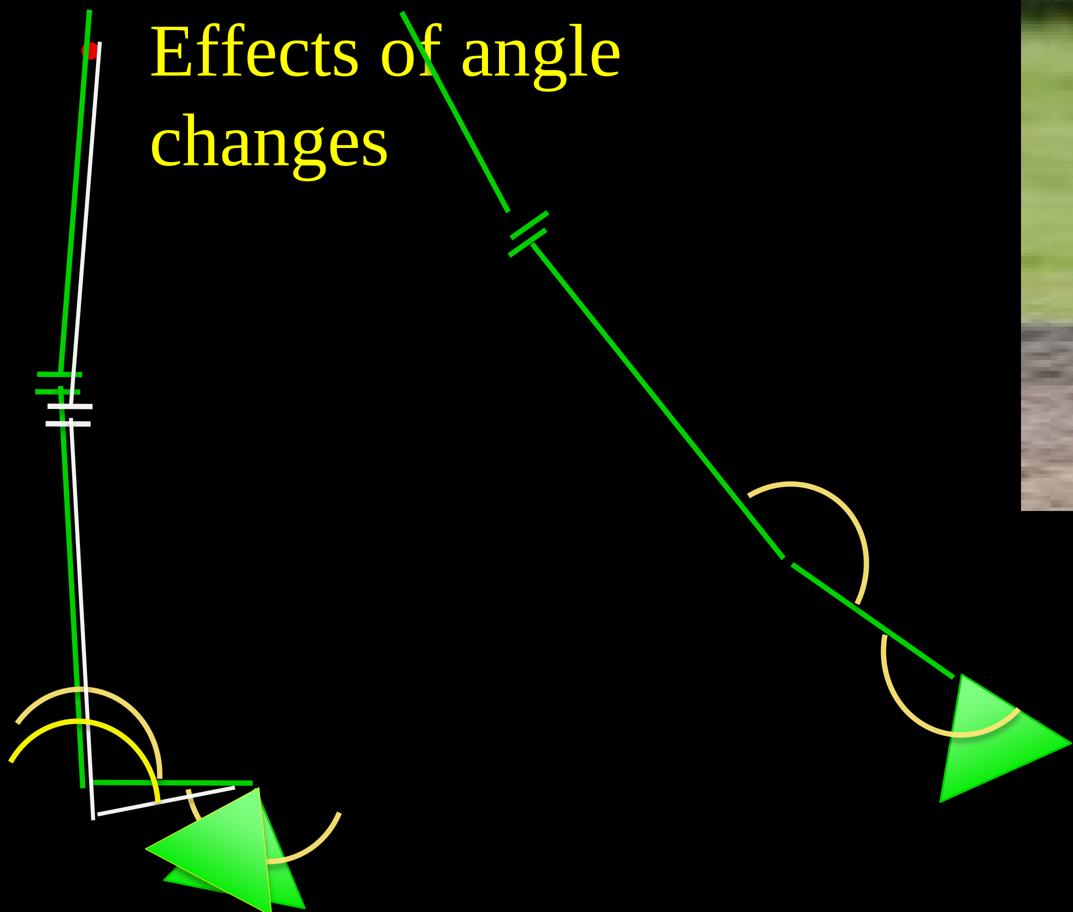
Man-made predilection to distal cannon bone injury

- Effects of angle changes

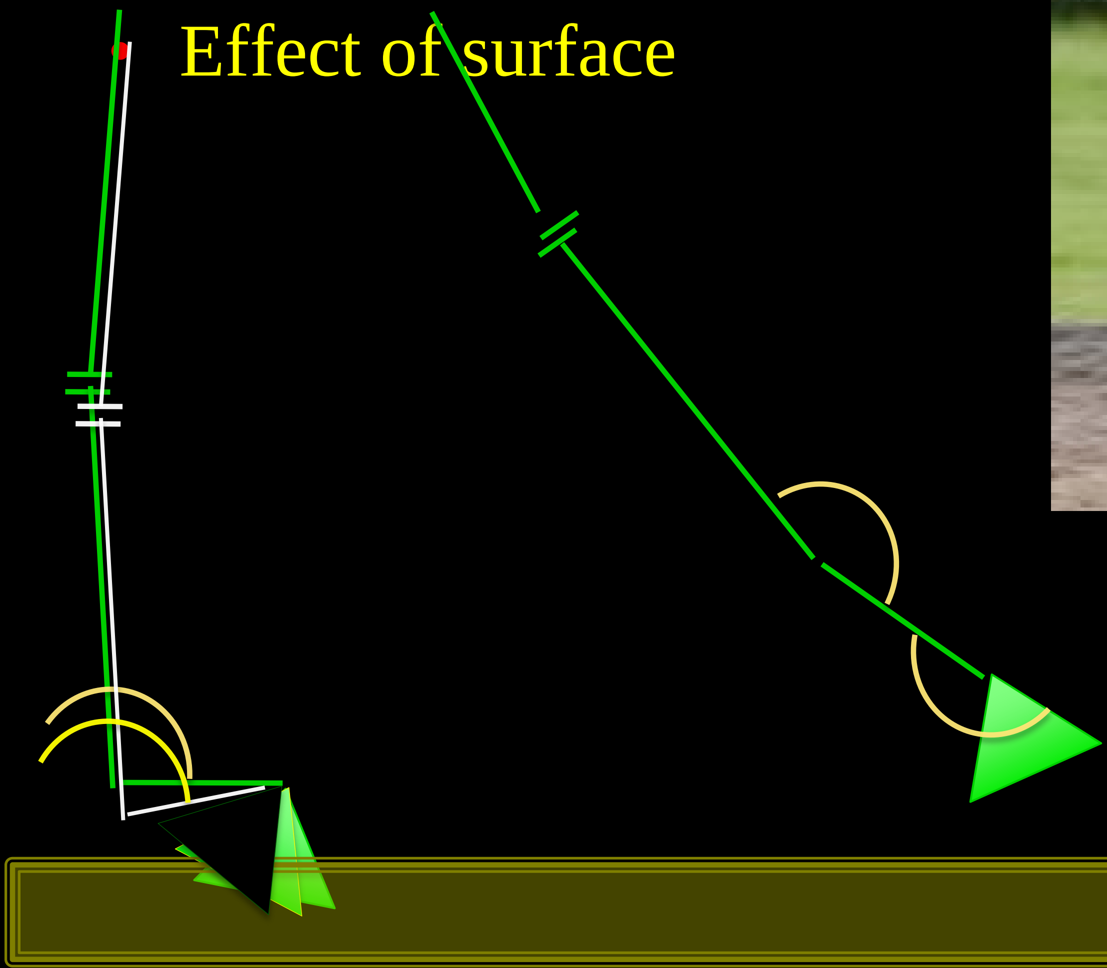


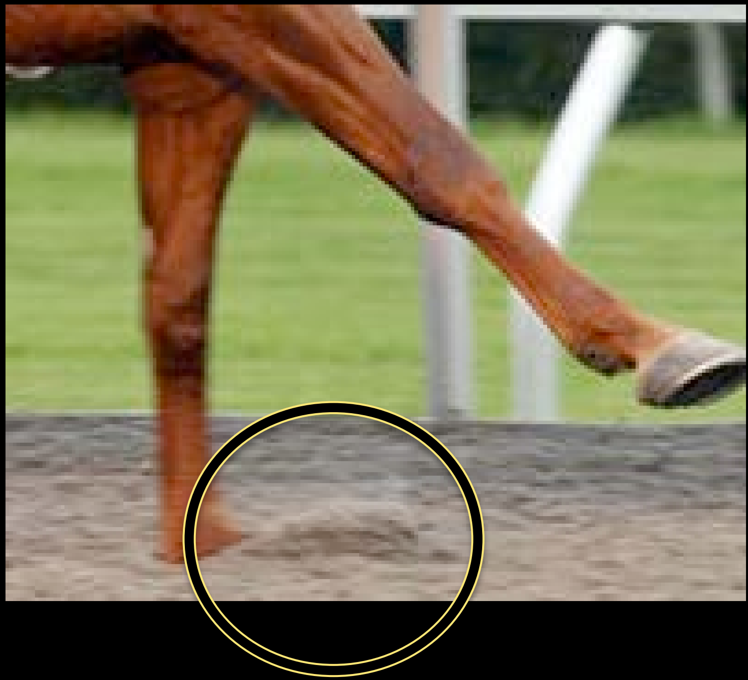
Man-made predilection to distal cannon bone injury

- Effects of angle changes

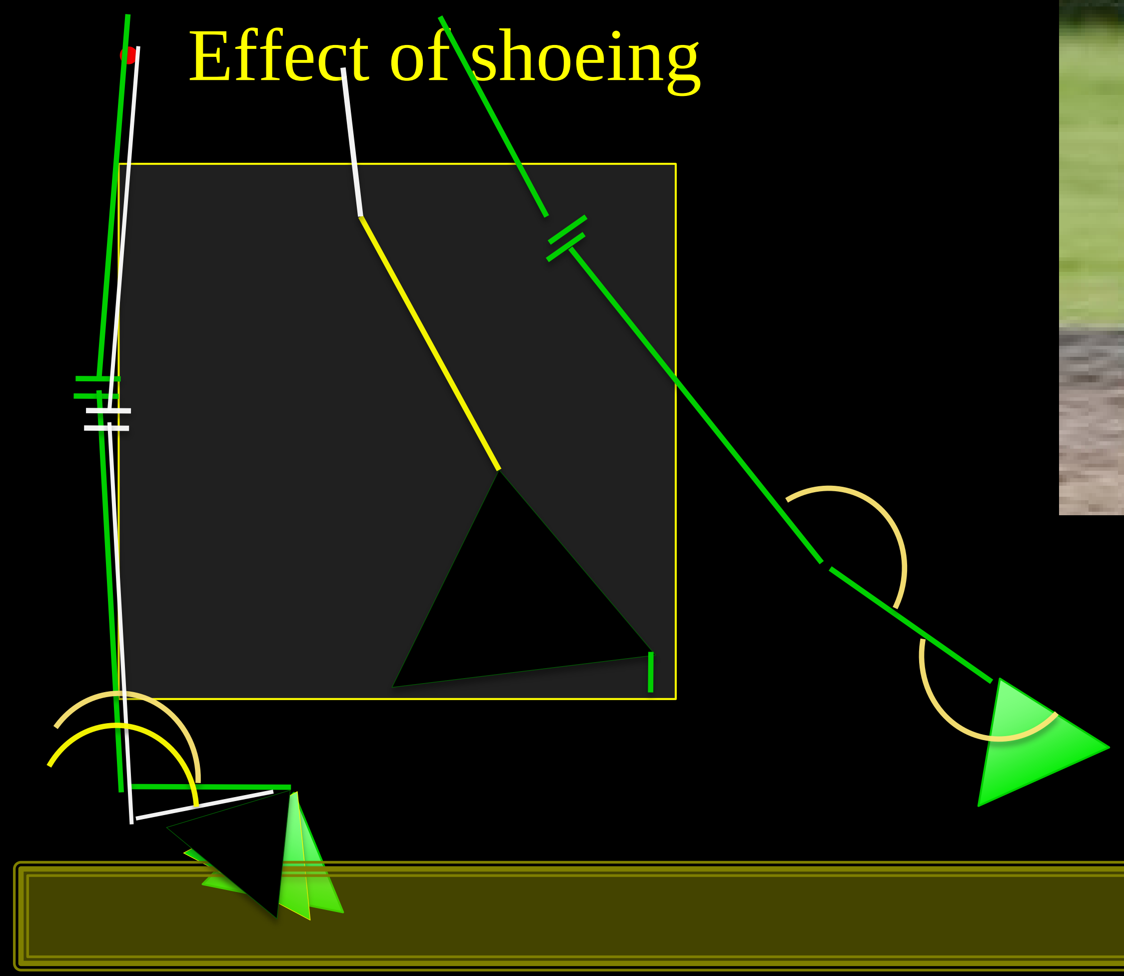


Man-made predilection to distal cannon bone injury



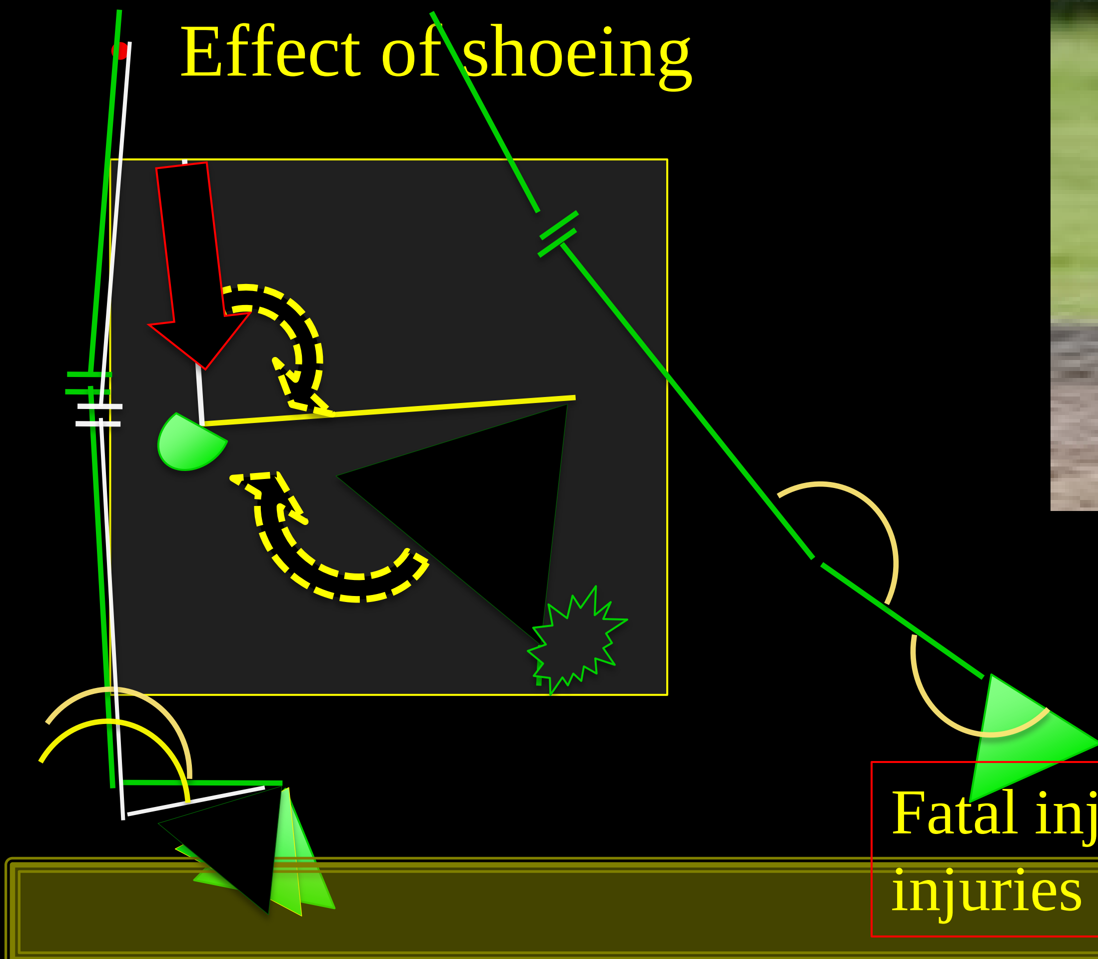


Man-made predilection to distal cannon bone injury



Man-made predilection to distal cannon bone injury

Effect of shoeing

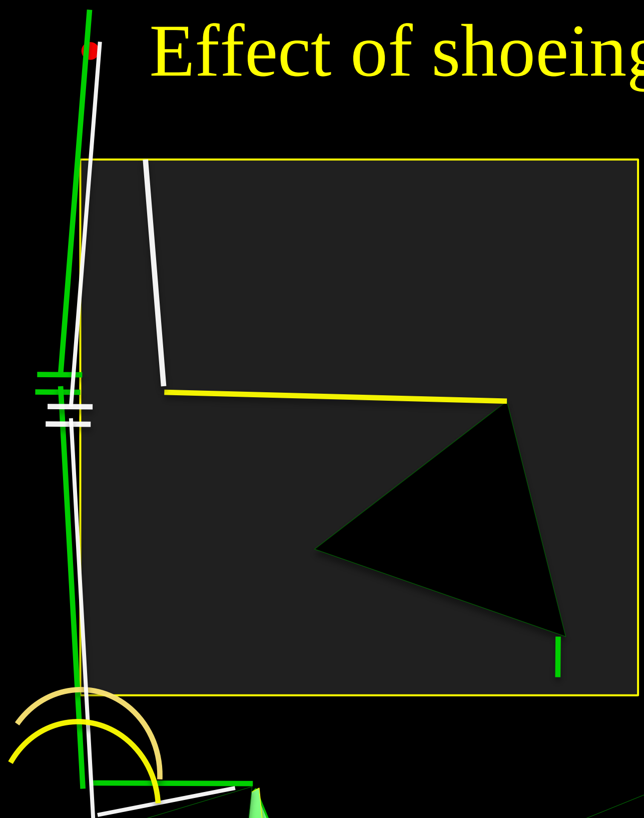


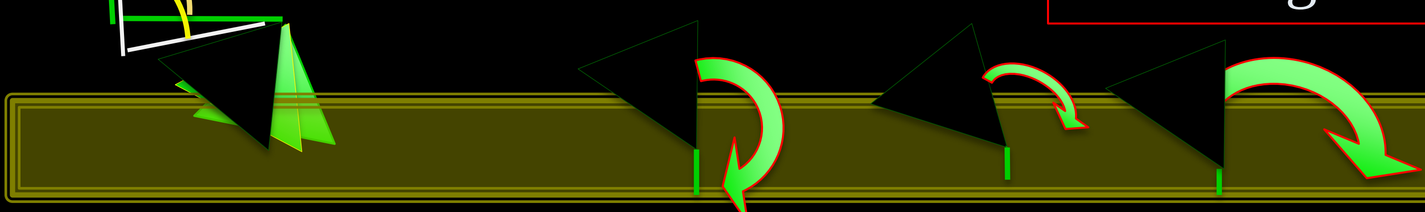
Increased braking
Increased "plow down"

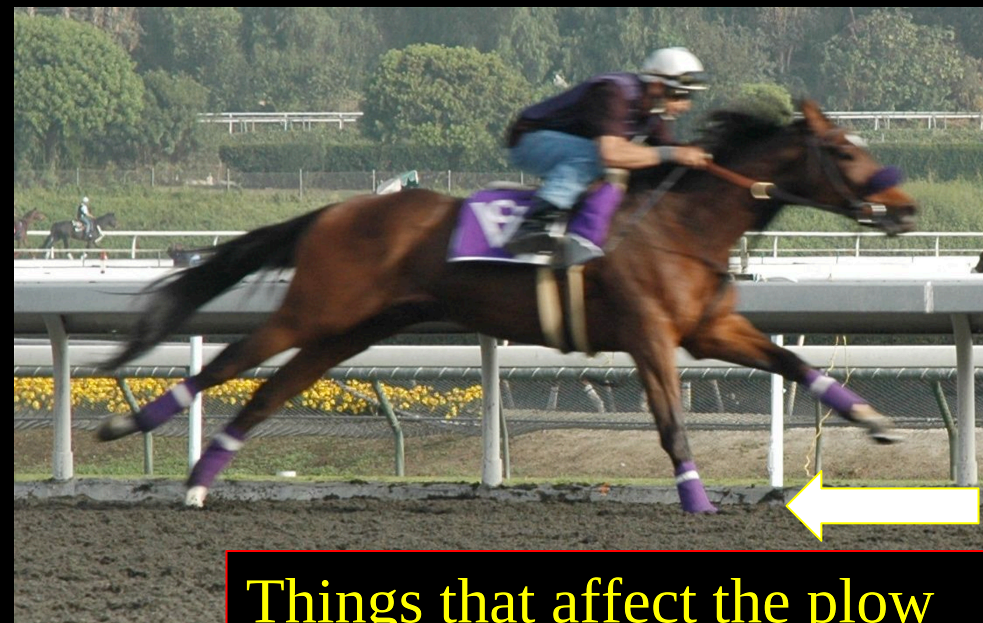
Fatal injuries are 95% fetlock injuries

Man-made predilection to distal cannon bone injury

Effect of shoeing



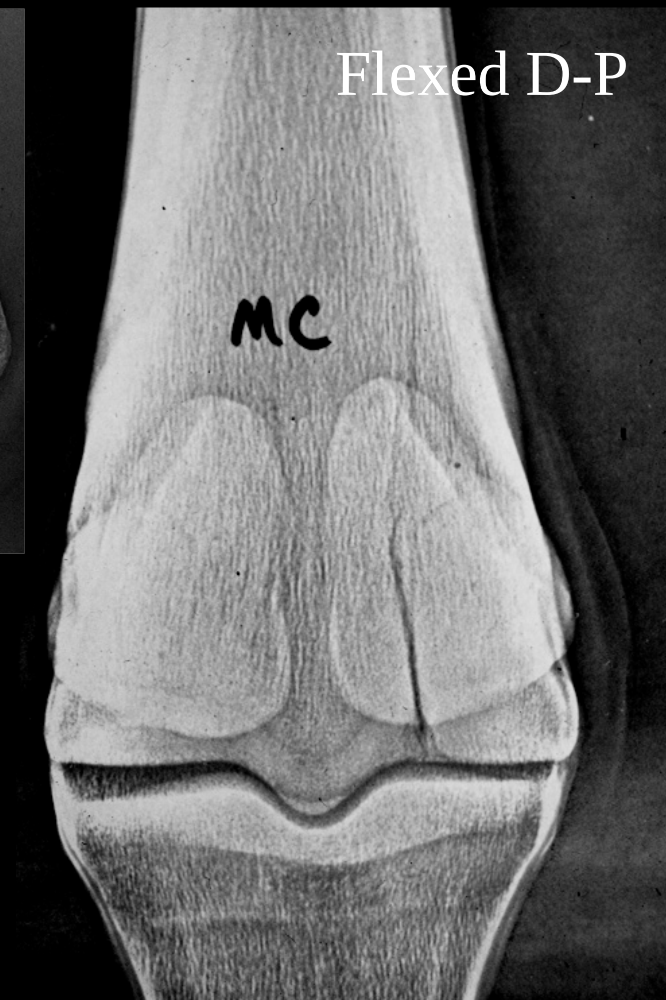




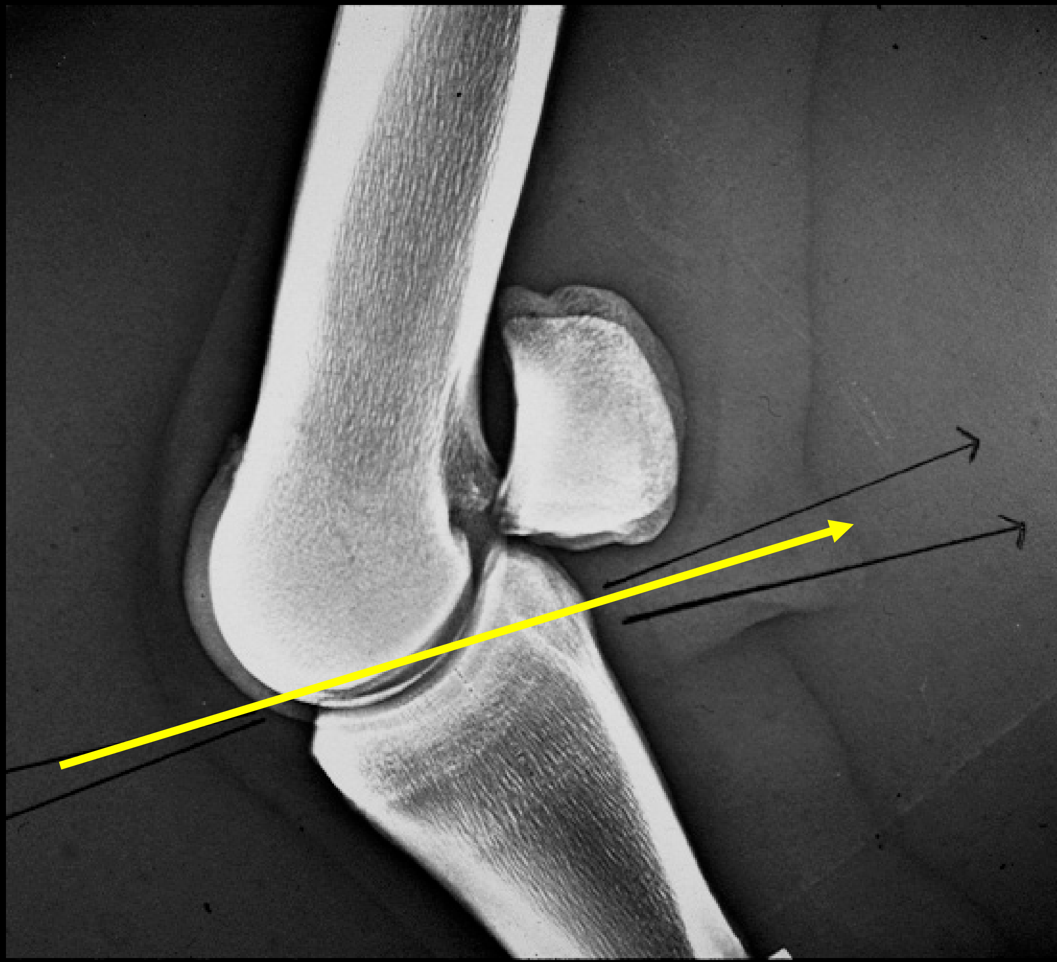
Things that affect the plow

- Height of toe grab
- Stiffness of surface
- Length of slide

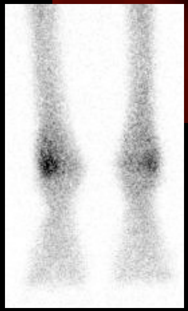
Our knowledge of the disease has greatly improved



Flexed D-P View



Posterior Articular Surface



Repetitive Cyclic Stress to the skeleton is the primary cause of lameness, and driver of skeletal modeling/remodeling

Relationship

Am J Vet Res. 1996 Nov;57(11):1549-55.

High-speed exercise history and catastrophic racing fracture in thoroughbreds.

Estberg L, Stover SM, Gardner IA, Drake CM, Johnson B, Ardans A.

Can we predict a condylar fracture?

- Is there a number of cycles/time that is too much?
- Question: Is it a “bad step” or are the injuries inevitable?

Question: Is it a “bad step” or are the injuries inevitable?

Likely Both!

- Some surfaces are more consistent.
- Sites of increased injury are not uniform.
- Normal bones are not vulnerable.

The energy it takes to fracture a normal cannon bone is huge!

Can we predict a condylar fracture?

horse_name	Race date	Total Furlongs	30 Days before race Furlongs	60 days before race Total Furlongs
Surgery Horses	**Average**	**16081**	**2108**	**3568**
162	**Median**	**12000**	**2100**	**3600**
NON Surgery Horses	**Average**	**18328**	**2142**	**3497**
324	**Median**	**13609**	**2100**	**3600**

Bone is not like Steel

“Assault” Schedule

1946

ASSAULT’S TRAINING SCHEDULE BEFORE WINNING TRIPLE COWN in 1946:

April 1 – Shipped to Belmont Park
April 5 – 3 furlongs in :37
April 6 – 6 furlongs in 1:14
April 9 – First start of year; won 6-furlong Experimental Free Handicap in 1:12
April 12 – 4 furlongs in :48 2/5
April 14 – 3 furlongs in :35 1/5
April 15 – 1 mile in 1:43 4/5
April 18 – 1 mile in 1:41 2/5
April 20 – Second start; won 1 1/16 Wood Memorial in 1:46 3/5
April 23 – 3 furlongs in :39; shipped to Churchill Downs
April 30 – Finished 4th in 1 mile Derby Trial 1:40 1/5; muddy track
May 3 – 4 furlongs in :48
May 4 – Won 1 ¼ mile Kentucky Derby by 8 lengths* in 2:06 3/5; sloppy track
May 5 – Walked
May 6 – Shipped to Pimlico
May 8 – 3 furlongs in :40
May 9 – 1 mile in 1:45
May 11 – Won 1 3/16 Preakness by a neck in 2:01 2/5; fast track
May 12 – Shipped to Belmont
May 16 – 4 furlongs in :52
May 18 – 3 furlongs in :40
May 20 – 4 furlongs in :48
May 22 – 1 mile in 1:43 3/5
May 24 – 3 furlongs in :35
May 25 – 1 ¼ in 2:05
May 28 – 4 furlongs in :50
May 29 – 1 ½ in 2:32
June 1 – Won 1 /1/2 Belmont Stakes by 3 lengths in 2:30 4/5; fast track

Paulick Report

140.5 Furlongs

Yes

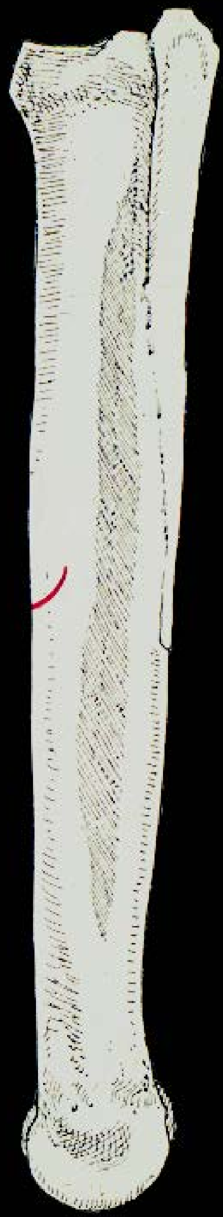
- Stress Fracture

Data From Retrospective Study Dallap, Bramlage EVJ

- 56 Horses
- Treated by intra-cortical fixation w/ 3.5mm screw and multiple 2mm drill holes

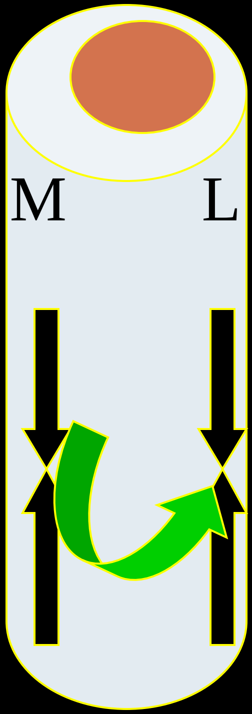
- Other described treatments
  - Rest
  - Screw alone
  - Drill alone
  - Shockwave
  - Electro-stimulation
  - Controlled Exercise
  - Firing
  - Other

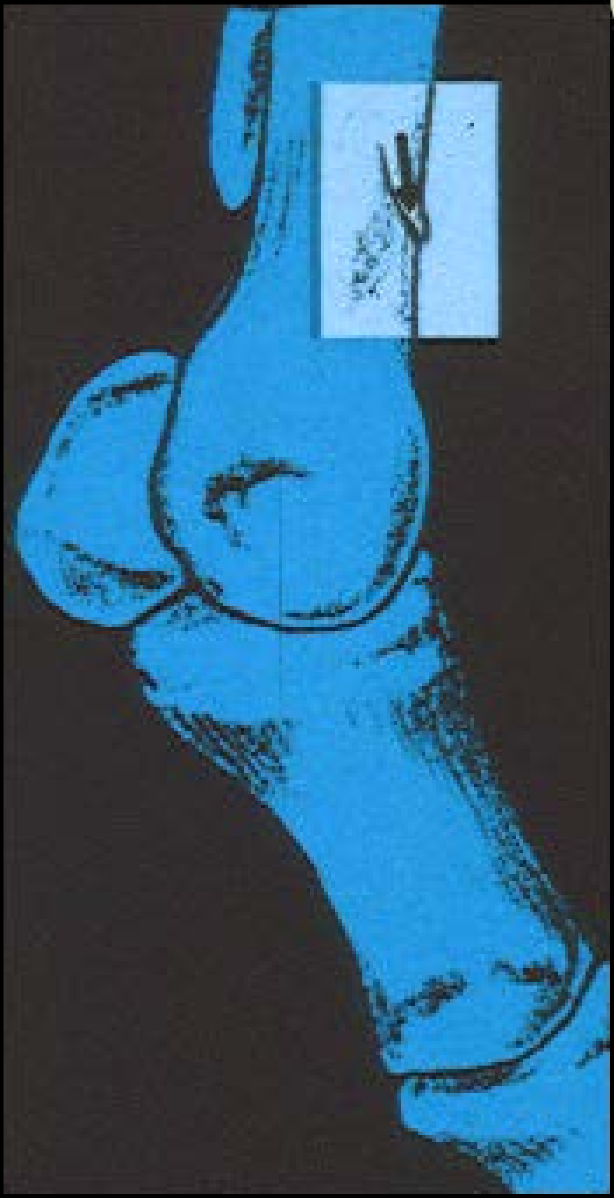
Almost exclusively a disease of the metacarpus of the racing Thoroughbred

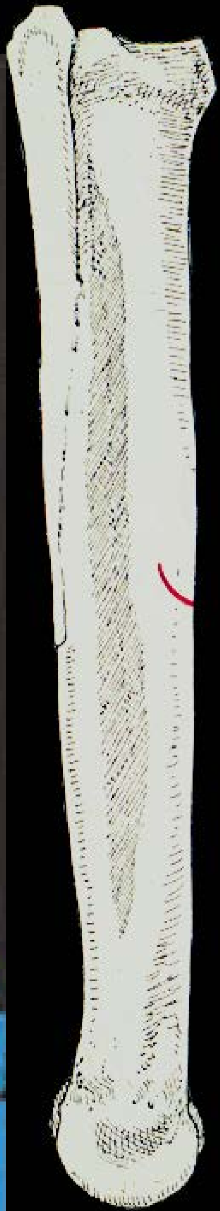


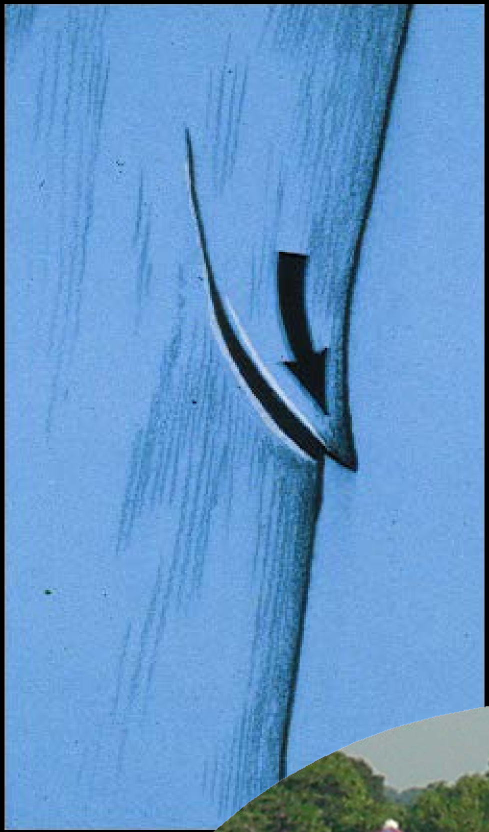
Pathogenesis

- Multiple cyclic loads
- Progressive accumulation of damage in excess or repair
- Predisposed by the change in biomechanics caused by increasing speed (Nunamaker)

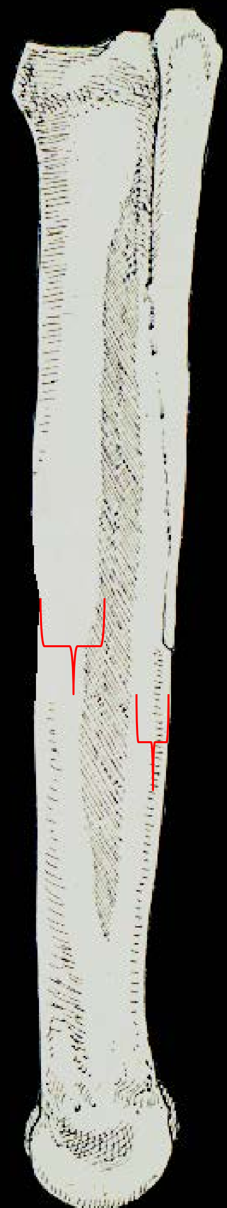


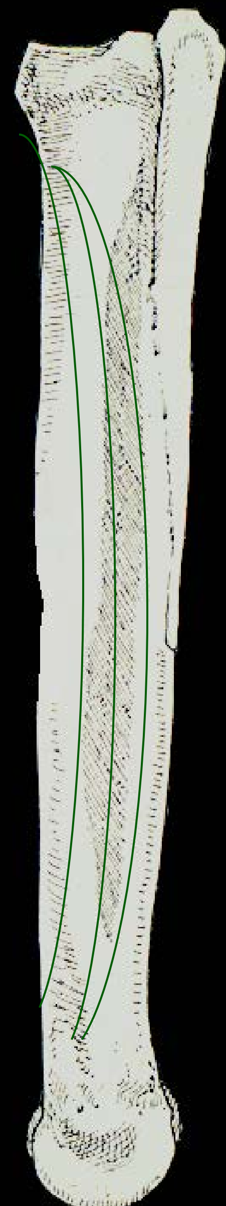




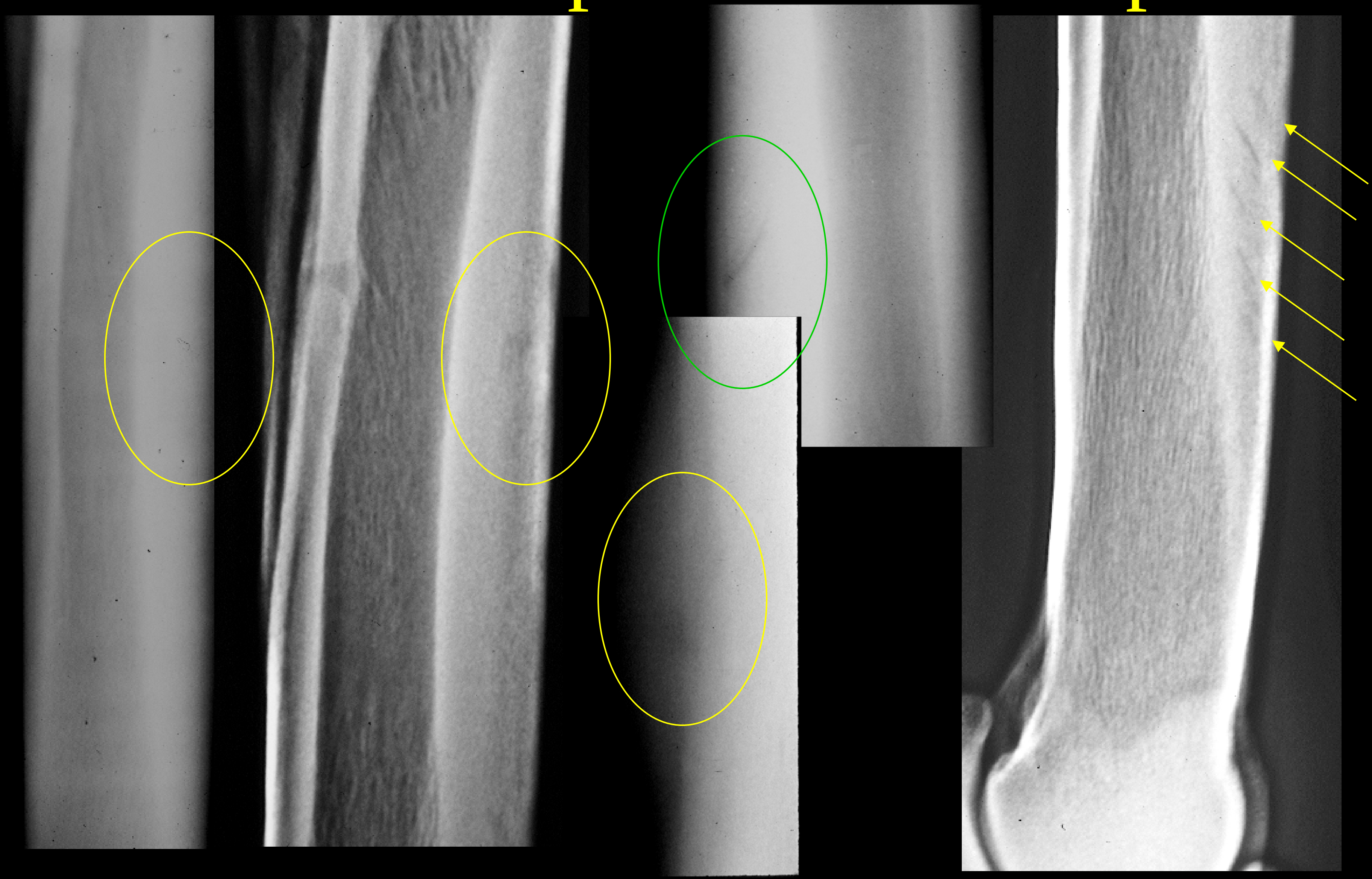


Stress Fracture configuration in a structure axially loaded in compression

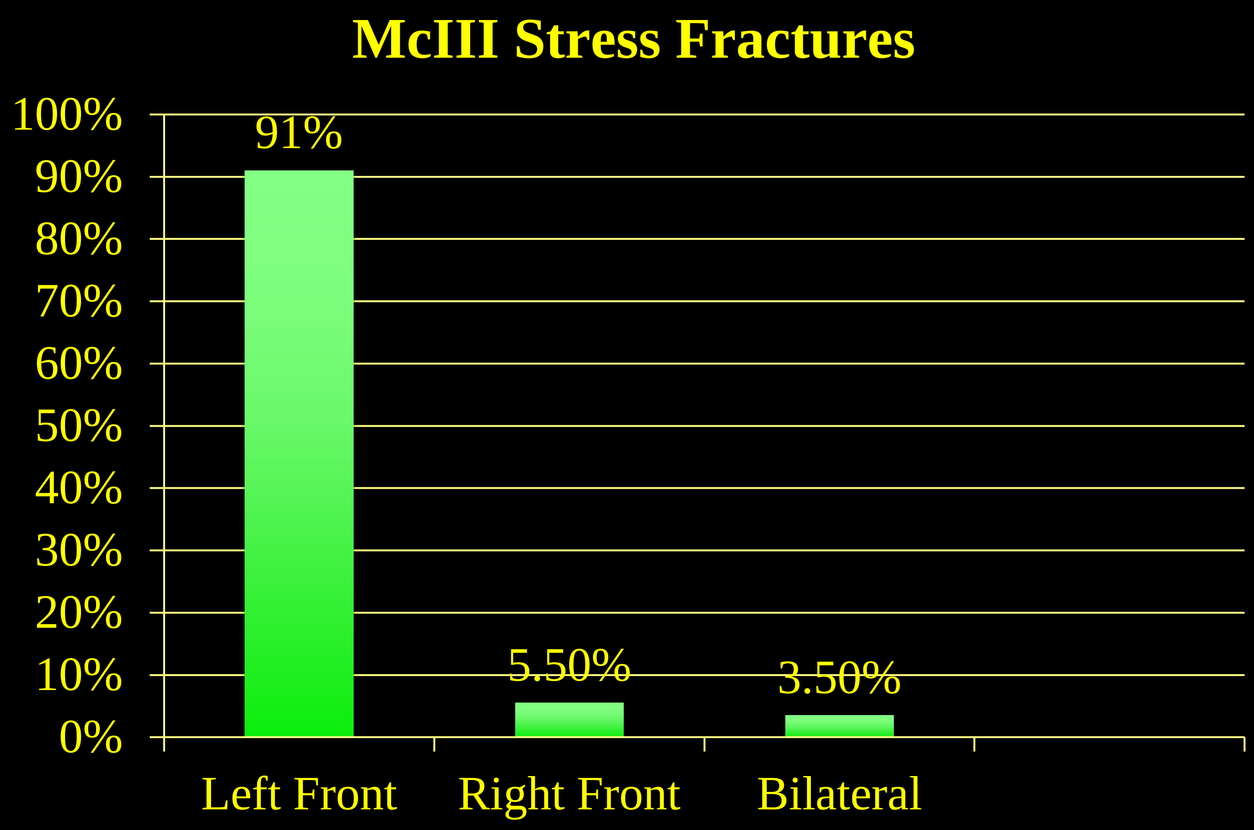


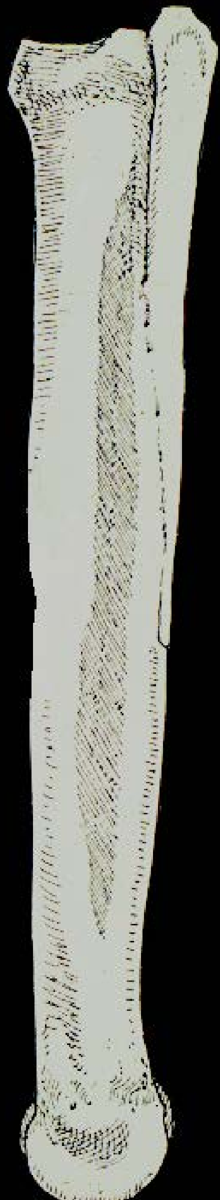
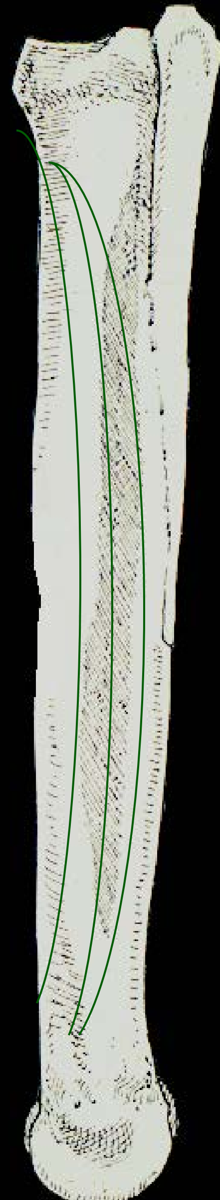


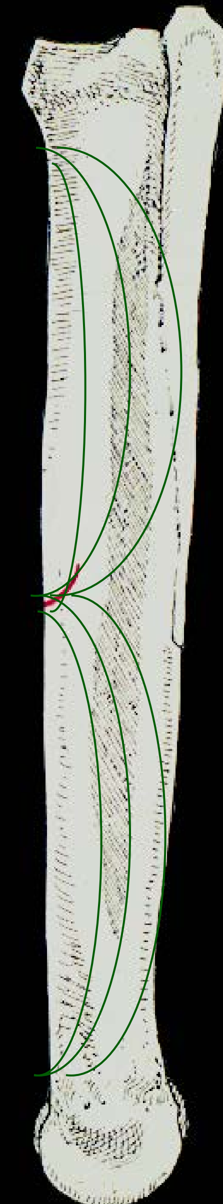
Stress Fractures are a part of the dorsal metacarpal disease complex



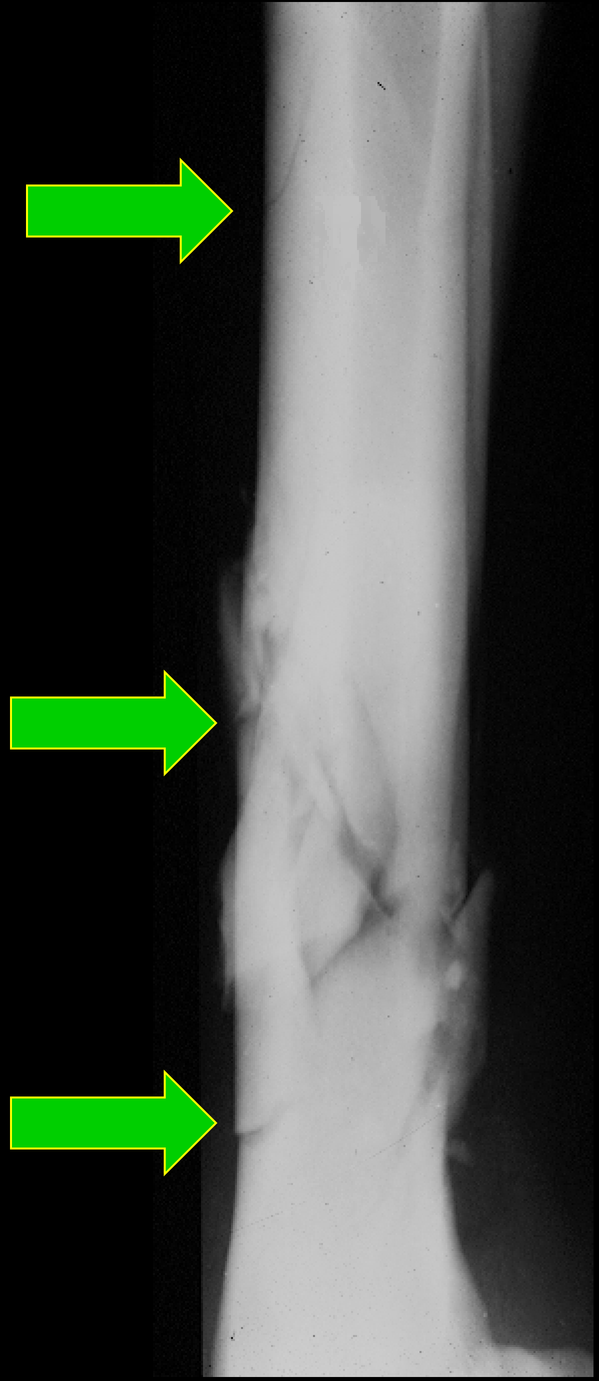
Distribution 61 Stress Fractures






P.



Tendonitis?

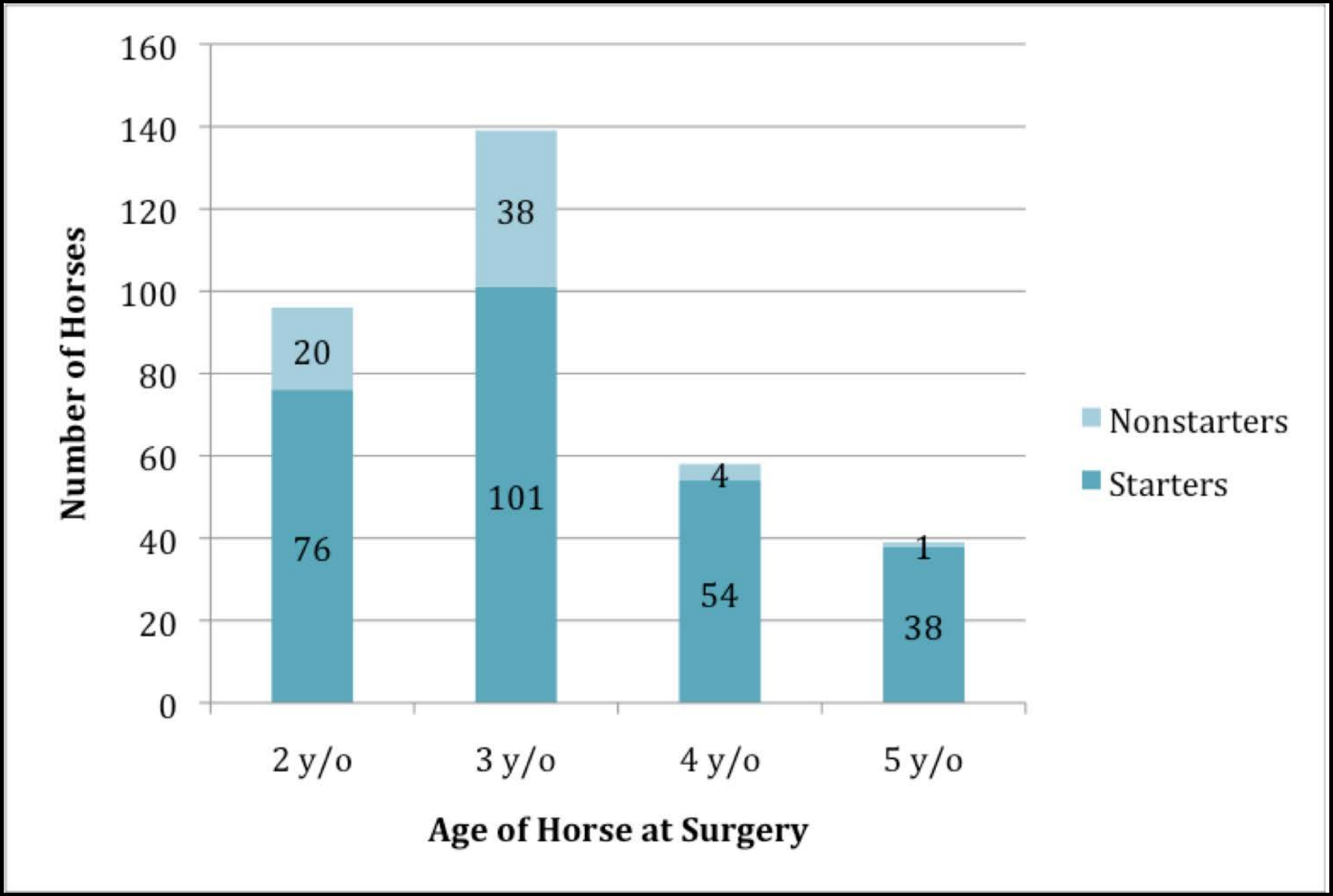
Racing performance of Thoroughbreds with superficial digital flexor tendonitis treated with desmotomy of the accessory ligament of the superficial digital flexor tendon: 332 cases (1989–2003)

Alaine J. Hu DVM, and Larry R. Bramlage, DVM MS

Objective—To assess postoperative probability of racing, career longevity, and convales- cent time in Thoroughbred racehorses with moderate to severe superficial digital flexor tendonitis (SDFT) in the forelimbs treated by desmotomy of the accessory ligament of the superficial digital flexor tendon (ie, superior check ligament desmotomy [SCLD]).
Design—Retrospective case series.
Animals—332 Thoroughbred racehorses with SDFT consecutively treated by means of SCLD.
Procedures—Medical records and racing records were reviewed to assess return to racing, number of races completed, time to first race, and lifetime performance. The horses were categorized as raced or unraced prior to and after surgery. Descriptive statistics including age and treated limb were also recorded.
Results—Of 332 horses, 228 (69%) returned to racing following injury and treatment. Seventy-eight of 118 (66%) horses that had not raced prior to injury and 150 of 214 (70%) horses that had raced prior to injury raced after treatment. Seventeen of 39 (44%) horses ≥ 5 years old raced following injury and treatment and 211 of 293 (72%) horses ≤ 4 years old returned to racing. There was no difference in the percentages of horses returning to racing for 2-, 3-, or 4-year olds. Postoperative infections occurred in 6 of the 332 (2%) horses. Me- dian time to first race for horses that raced after surgery was 302 days (range, 48 to 1,120 days; mean ± SD, 341 ± 153 days), with a median of 8 starts/horse after surgery (range, 1 to 109 starts; mean ± SD, 14 ± 15.8 starts). Of 228 horses that returned to racing, 159 (70%) raced ≥ 5 times after surgery. Sex and treated limb did not have a significant effect on return to racing. However, horses ≥ 5 years old were significantly less likely to return to racing, compared with younger horses. In horses with unilateral SDFT and < 5 starts, the affected and contralateral limbs were both treated, but return to racing was not significantly different between horses treated bilaterally versus unilaterally.
Conclusions and Clinical Relevance—228 of 332 (69%) horses with SDFT of the forelimb treated with SCLD successfully returned to racing. Convalescent times were shorter, com- pared with previous recommendations, and treated horses had a longer racing career after surgery than has been described for other treatment modalities. The results of the present study support consideration of SCLD as part of a treatment plan for SDFT in Thoroughbred racehorses.

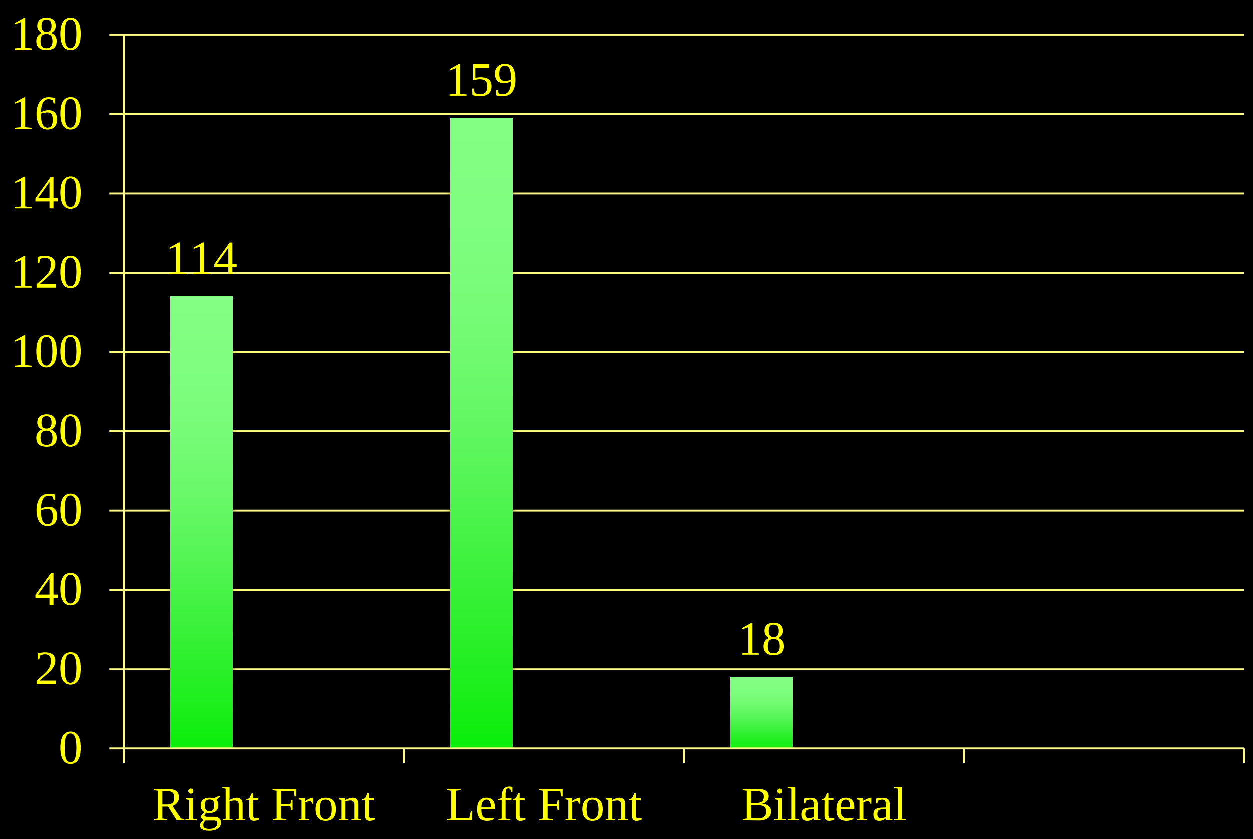
(J Am Vet Med Assoc 2014;244:1441–1448) June 15, 2014

Results



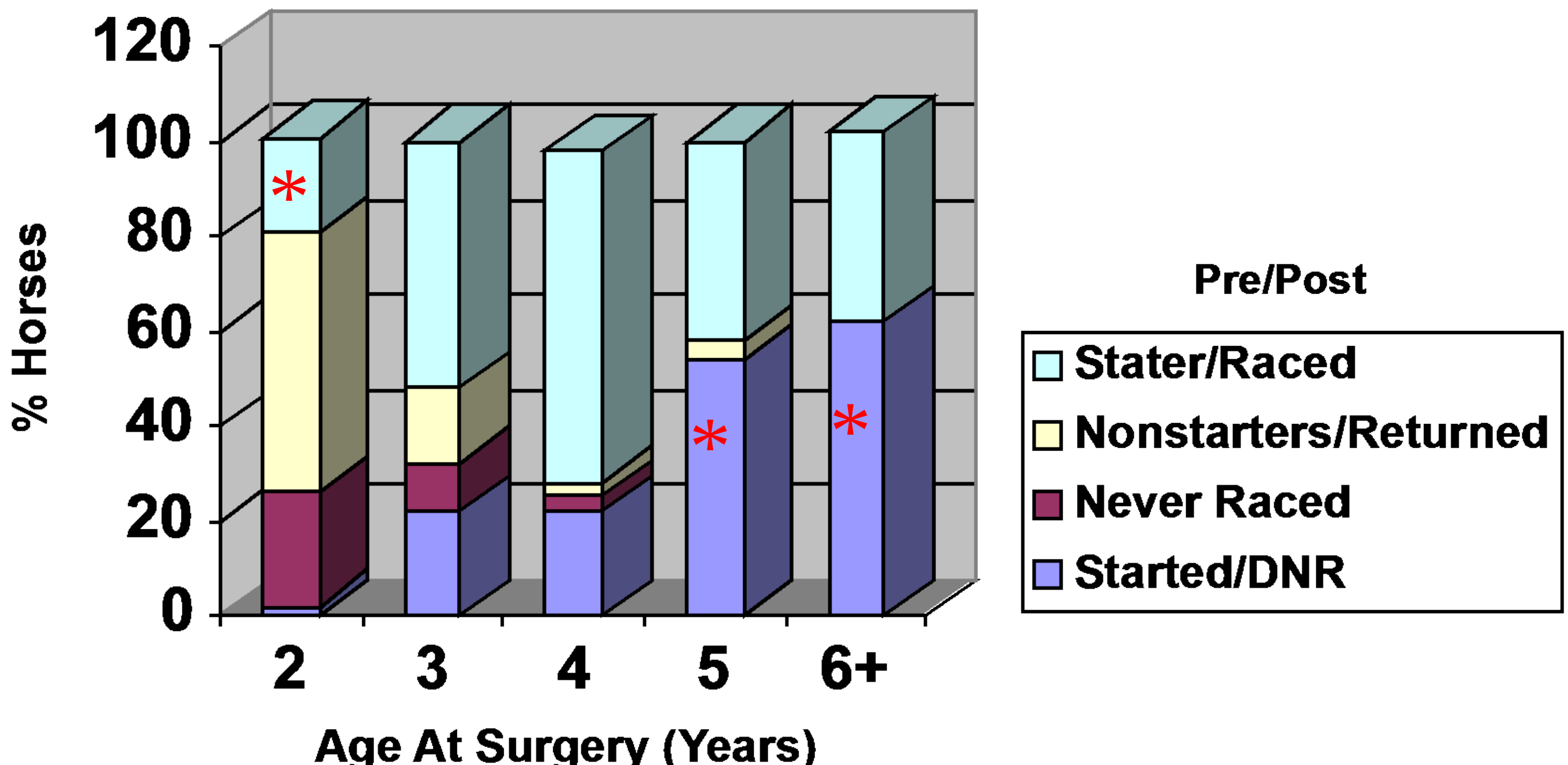
160
140
120
100
80
60
40
20
0
Number of Horses
38
20
101
76
4
54
1
38
Nonstarters
Starters
2 y/o
3 y/o
4 y/o
5 y/o
Age of Horse at Surgery

Results



180
160
140
120
100
80
60
40
20
0
114
159
18
Right Front
Left Front
Bilateral

Results
Age Effects on Racing Status



* = significant

44% of horses ≥ 5 years old at the time of surgery raced

Why is this easier on a horse's skeleton than race training?

- Surfaces are irregular
- Loads are abrupt and irregular
- Riders are larger

Can we alter this?

- Work in straight lines not circles?
- Vary the gaits
- Allow some training in both directions

At what level is cyclic fatigue creating structural damage?

- Excessive galloping
- High speed furlongs

?