Tendon

Wessex Regional SpR Training
Miss Nikki Kelsall
Potential Viva Questions

- What is the structure of collagen?
- Describe the blood supply of tendons
- How do tendons heal after injury?
- Draw the stress-strain curve of a tendon and explain its parts
- Discuss injuries to tendons and mechanisms of fatigue failure.
Dense yet flexible: regularly arranged fibrous tissue that attaches muscles to bone.
Basic Science

- Cells – fibroblasts

- Extra cellular matrix - mainly Type 1 Collagen

- Insertion into bone via 4 transitional tissues:
  - Zone 1 tendon
  - Zone 2 fibrocartilage
  - Zone 3 mineralised fibrocartilage
  - Zone 4 bone
  - Sharpey’s fibres

- Musculotendinous junction
DNA transcription - mRNA identifies the specific α chain configuration

Hydroxylation occurs on the ribosome (with O₂)

Transfer RNA adds specific amino acids during transport to the Golgi apparatus

Polypeptide chains aggregate into a triple helix - procollagen

Joined by galactose

Released from the fibroblast

Terminal peptides removed by peptidases

Tropocollagen aligns by hydrogen bonding

Stable crosslinks are formed

Aggregation of collagen fibrils
Blood and Nerve supply

- Vascular - Paratenon covered
- Avascular – Synovial sheath, **mesotenon**

- Mainly afferent nerves
- Proprioception
Biomechanics

Load-Elongation curves

- Modulus of elasticity
  \[ E = \frac{\delta}{\varepsilon} \]

Visco-elasticity

- Stress strain behaviour related to time and rate
  - viscous > creep (low loads)
  - Elastic > unchanged (high loads)

- Hysteresis
- Stress relaxation
- Creep

- Affected by:
  - Age, endocrine, pharmacology, immobility
Nature of Injury

- Repetitive **micro**-trauma
  - Inflammatory reaction
  - calcification
- **Macro**-trauma

- Cross-sectional area
- Force of muscle contraction
Types of Injury

- **Grade I**  some pain, no joint laxity
- **Grade II**  severe pain, some joint laxity
- **Grade III** initial severe pain, joint instability

- Avulsion (bony/non-bony)
- Tendon substance
- Tendomuscular junction
Tendon healing

- **Phase**
  - 1 Haemorrhagic, inflammatory
  - 2 Proliferative
  - 3 Remodelling

- **Weakest at 7-10 days**
- **Regain most strength at 21-28 days**
- **Maximum strength at 6 months**
Factors affecting healing

- Early mobilisation
  - ROM
  - Strength

- Immobilisation
  - ROM
  - Strength

- Surgical technique
- Biological/biochemical
- Joint instability
Graft attachment to Bone

- Hamstring
  - Indirect: tendon to bone
    - Sharpey's fibres bond ligament to periostium

- BPTB
  - Direct: bone to bone
When is the graft fixed?

**BPTB**
- Bone-Bone interface strong at 6 weeks
- Sharpey’s fibres strong at 12 weeks
- Direct attachment

**Hamstring**
- Collagen fibres appear at 4 weeks
- Sharpey’s fibres solid at 12 weeks
- Indirect attachment

Rodeo et al 1993 JBJS. 75A:1795
When can Physio Increase?

- Evidence of graft fixation on to bone tunnels
  - 6 weeks for BPTB
  - 12 weeks for Hamstring
  - *Tibial Fixation* is weakest until this time

- Revascularisation phase of graft remodelling occurs in animal studies between 8 – 10 weeks
  - *Graft* is weakest at this time
How do Tendons differ from Ligaments?

- Attach bone to bone
- 70% Type I Collagen
- Higher elastin content
- Uniform microvascul arity, receiving supply at the insertion site
- Greater proprioception
- Insertion either direct or indirect
- Immobility adversely affects repair
Other ‘tendon’ things to read about

- Tendinitis
- Tendon transfer/Tendon lengthening
- Common injuries
  - Achillies
  - Patella
  - Quadriceps
  - Biceps
  - Hand and wrist
Which of the following statements about the mechanical properties of tendon is true?

a) Ruptured tendons show histological evidence of inflammation
b) Ruptured tendons show histological evidence of degeneration
c) Tendons are strongest in compression
d) Tendons consist mainly of type II Collagen
e) Tendons can withstand up to 25% strain prior to rupture
MCQ 1

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MCQ 2

Due to which of the following does traumatic failure of tendon function most commonly occur?

a) Osteotendinous junction rupture
b) Tendon body rupture
c) Musculotendinous junction rupture
d) Muscle belly rupture
e) Avulsion fracture
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- a) Ulna
- b) Trapezoid
- c) Scaphoid
- d) Trapezium
- e) Capitate
MCQ 3

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MCQ 4

Which tendon most commonly ruptures in RA?

a) FPL
b) FDS
c) EDM
d) EDC
e) EPL
MCQ 4

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a) Zone I
b) Zone II
c) Zone III
d) Zone IV
e) Zone V
MCQ 5

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Achilles tendon rupture

a) Is more common in elderly women
b) Is often associated with tendonitis
c) Usually occurs about 2-3 cm proximal to the calcaneal insertion of the tendon
d) Can be managed either surgically or non-operatively
e) Treated surgically has a re-rupture rate of less than 5%
**MCQ 6**

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Tendon

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