Translational Imaging:
Animal Models for Study of Tendon and Enthesis in Musculoskeletal Disease

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Commonly used models for study of tendon healing:

1. Chicken flexor tendon

Advantages:

- Intra-synovial tendon similar to humans
- Cost effective

2. Canine flexor tendon

Advantages:

- Allows post-operative protection (casting, splinting)
- Can do daily rehabilitation (manual range of motion)

3. Rat rotator cuff

Advantages:

- Shoulder anatomy similar to humans (coraco-acromial arch)
- Cost effective
- Numerous molecular markers/antibodies available

4. Sheep rotator cuff

Advantages:

- Size similar to humans - allows use of standard implants (for ex, extracellular matrix patches for rotator cuff)
- Some have tried to protect post-operatively using a large ball on the hoof to diminish weight bearing
- MRI can be used to evaluate tendon healing

- CT scan in live animal under anesthesia

5. Goat rotator cuff

Advantages:

- Size similar to humans - allows use of standard implants (for ex, extracellular matrix patches for rotator cuff)
- Infraspinatus has 2 separate heads – can theoretically use one head and the intact head "protects" the repair

6. Rat Achilles tendon

Advantages:

- Cost effective
- Numerous molecular markers/antibodies available

7. Rat models allow careful control of post-operative mechanical loading of repaired tendon:

- External fixator to immobilize the limb, combined with daily loading of repair site (such as by joint motion with animal under anesthesia).
- Botox injection to temporarily paralyze the muscle

Imaging modalities that can be used for various animal models with animal under anesthesia:

1. Standard radiographs
2. Positron-emission tomography- rodents. Allows assessment of metabolic processes (inflammation, glucose uptake, osteoblastic activity, etc.)
3. High resolution radiographs (Faxitron)
4. MRI (7 T) - small bore, so only accomodates rodents.
5. Standard MRI on explanted specimen

6 Small animal microCT (live animal)

7. Ultrasound (has been used in sheep rotator cuff repair model)

8. Multi-photon microscoopy - allows measurement of collagen fiber organization. Depth of penetration is from 200 to 500 microns depending on the objective used and the type of tissue imaged - - could potentially allow imaging of superficial tendon through skin (patellar tendon, Achilles tendon)

9. Optical coherence tomography. Has been used to evaluate superficial matrix changes in cartilage. Applicable to tendon??.