

Turkey model for flexor tendon research – can it replace the canine model?

Battlefield hand injuries accounted for 20 to 30% of combat wounds during Operation Iraqi Freedom, in which, soft tissue injuries compromised the majority in hand trauma. Flexor tendon injuries are among the most severe of hand injuries, with a high demand in functional recovery.

Animal models of tendon injury are commonly used for in vivo and in vitro studies, aiding understanding of the pathology related to this injury which improves management and development of novel therapeutic options.

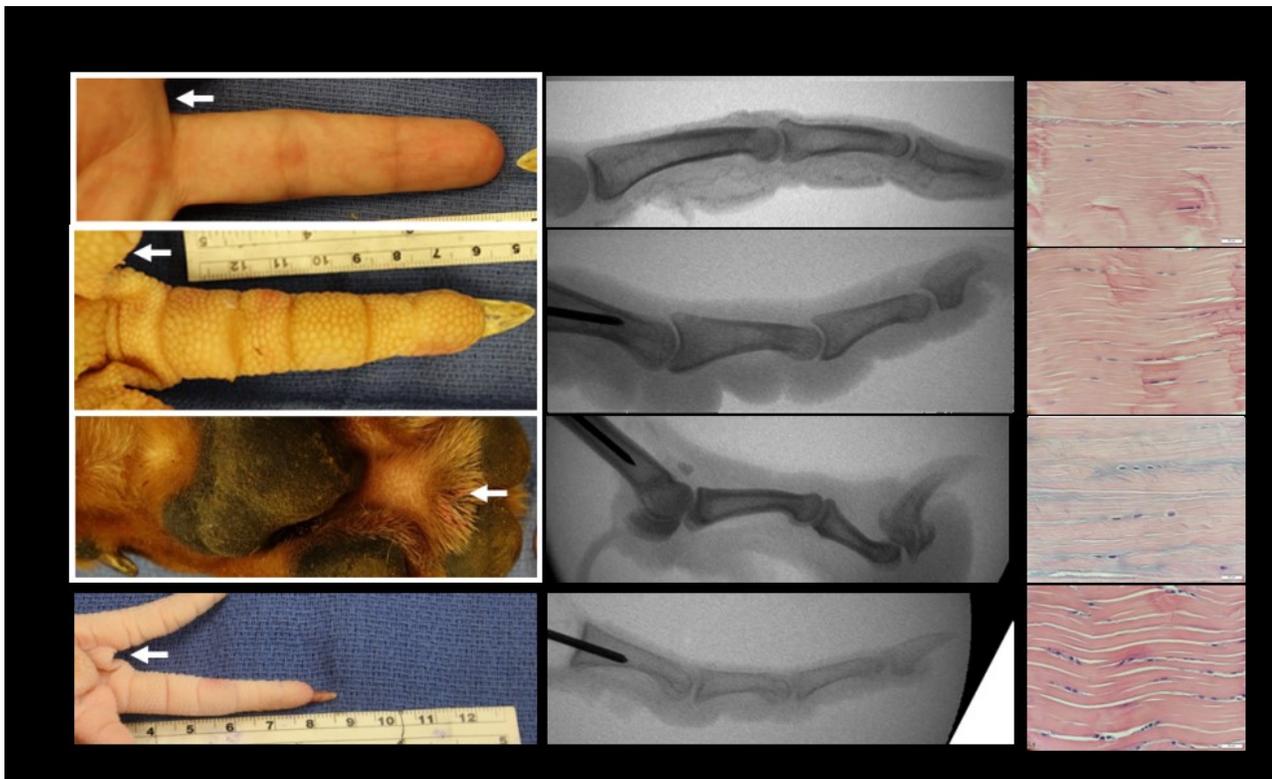


Fig. 1. Digit photo (left column based on real scale), digit x-ray (middle column) and histology (right column H&E staining) of human, turkey, canine, and chicken. White arrows indicate the digitweb (skin connected between digits) in different species.

Canine Model - Advantages associated with the canine model include anatomical and biomechanical similarities to humans (both are of the mammalian superfamily) and the relative ease of training resulting in better post-operative therapy simulation. Aside from some dissimilarities in structure and blood supply, the major disadvantages of the canine model include

high costs and ethical considerations of research with human companions.

Chicken Model - The chicken model also presents some similarities to human flexor tendon at a lower cost compared to mammalian models. However, its small tendons cannot be used for advanced tendon research, especially when surgical repair or graft is performed.

Our central hypothesis was that the turkey flexor tendon will be similar to the human flexor tendon in size, shape, and biomechanical properties.

An in vitro anatomical, functional and biomechanical comparative trial was performed between 4 species (n=6): 3rd digit from forepaws of Canines, 3rd digit from feet of white leghorn chickens, 3rd digit from feet of Broad Breasted white turkeys, 3rd digit from fresh human cadaver hands.

The following parameters were compared between all species: Basic anatomy of the flexor apparatus, joints range of motion, tendon excursion and cross-sectional area, work of flexion (WOF), gliding resistance, simple suture pull out force, tendon Young's modulus, and histology.

Anatomically, the turkey digit was more similar to the human digit than canine digits with regards to the deep and superficial flexor tendons of the pulley system and the lack of web between digits (Fig. 1). As in human tendons, blood supply to turkey tendons comes from two vinculum as opposed to one vinculum in the canine (Fig. 2). The cross-sectional area of turkey tendons was similar to that of human, especially in the region common for tendon injuries.

Tendon gliding resistance was highest for human digits and probably reflects the close relation of the FDS to FDP at that area. Turkey gliding resistance was the closest to human, while canine had the lowest gliding resistance of all species.

The force required to pull a simple suture out of the tendon was similar between human and turkey, and was significantly higher for canine. This finding reflects the different histology featured for the canine tendon with an abundance of fibrocartilage alongside the pure tendinous tissue.

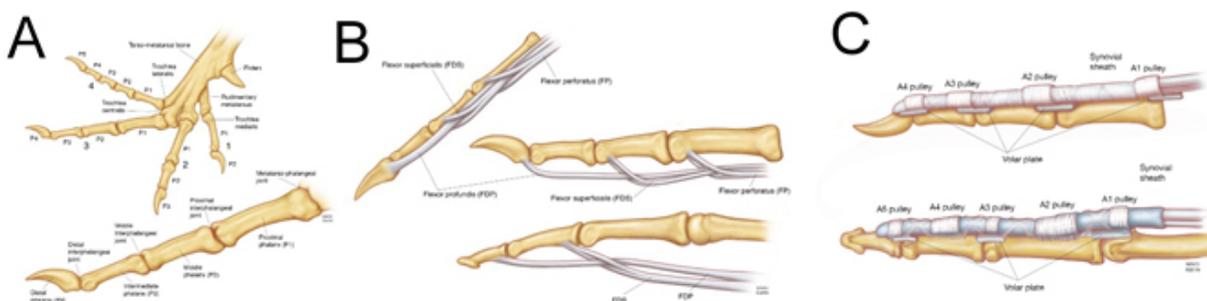


Fig. 2. A Skeletal anatomy of the turkey foot B Anatomy of the flexor apparatus of the turkey from the volar view (top) and lateral view (middle), compared to the human flexor apparatus from the

lateral view (bottom). C the anatomy of the flexor sheath and flexor pulleys of the turkey (top) and human (bottom).

We, for the first time, have explored the turkey digit and flexor tendon in anatomy, structure, and function compared to human and species commonly used in tendon research (canine and chicken). We found that the turkey flexor tendon is similar to a human tendon in shape, size, structure, histology, and biomechanical properties. In some aspects, such as vasculature, lack of finger webs and tendon size, the turkey tendon is superior to the canine and chicken as a model for humans.

In Conclusion, Many turkey flexor tendon properties are similar to human flexor tendons. The turkey could be a clinically relevant, economical, non-human-companion large animal model for flexor tendon research.

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