EVALUATION OF GAIT QUALITY FOR A NOVEL TENDON-TRANSFER SURGERY IN A CHICKEN MODEL

Le, A1, Browning, GR2, Warnock, JF2, Sweeney, J1, and Balasubramanian, R1
1College of Engineering, Oregon State University, Corvallis, OR USA
2College of Veterinary Medicine, Oregon State University, Corvallis, OR USA
email: leanth@oregonstate.edu, web: www.anthonylee.com

INTRODUCTION
The conventional tendon-transfer surgery for high-median ulnar nerve palsy involves directly re-routing multiple finger flexor tendons from the Flexor Digitorum Profundus muscle bellies and suturing them to the one Extensor Carpi Radialis Longus muscle belly [1, 2]. While this procedure restores finger flexion, it couples the movements of all four fingers and prevents them from individually adapting to an object’s shape during grasping tasks. To address this limitation, our group is developing a new surgical procedure that constructs a differential mechanism in-situ in the forearm using the biological tendons and the artificial strut-shaped implants. Our previous studies using biomechanical simulations, human, and chicken cadavers have shown that this implant-based surgery significantly improves adaptability of the fingers in physical interaction tasks [3, 4, 5, 6]. Therefore, as the next step, our group conducted a pilot in vivo chicken study to evaluate the postoperative walking functionality and healing responses for this novel surgery [7]. This paper aims to underline the significance of the gait scores from the live chicken study.

METHODS
The implant was made of autoclaved ultra-high-molecular-weight polyethylene. Twenty-nine Cornish Cross chickens were randomly assigned to one of the three treatment groups: control (n=7), implant (n=12), and sham (n=10). During the surgery, the Extensor Digitorum Longus (EDL) tendon was exposed with a 1.5cm incision on the dorsal side of the leg at approximately the same level as the spur. Then, the EDL tendon was dissected from the surrounding connective tissue at the bifurcation. The implant was placed under and sutured to the EDL tendon branches approximately 10mm distal to the bifurcation with simple interrupted stitches using 5-0 Prolene. The skin was sutured closed with an apposing cruciate pattern using 4-0 Nylon. The sham group underwent the same surgical procedure without implant insertion. Instead, each tendon branch was simply sutured with 5-0 Prolene. The control group did not undergo any surgical procedures. Walking functionality was periodically assessed on a gait scoring system published in the British Poultry Science journal and validated by the USDA for scoring lameness in bubble feet [8]. This scoring system scales from 0 to 5 where 0 denotes normal walking and 5 denotes complete lameness. After approximately 5 to 10 weeks, the chickens were euthanized and legs were harvested for routine histopathology. A two-sided Wilcoxon rank-sum test was used for statistical analysis of all gait scores collected from the implant and sham groups within the first 30 days following surgery (Figure 1).

RESULTS AND DISCUSSION
For the first several days following surgery, the implant and sham groups demonstrated some abnormalities in their gaits and scored between 1 and 2 but quickly improved over time. These pilot results revealed a significant difference in gait scores between the implant and sham groups for 8 of the first 30 days postoperative (Figure 1; p<0.05). However, it is worth noting that even though some days showed a significant difference in gait scores, both groups converged well below 1 which indicated promising walking functionality overall and similar responses to surgical injury.

CONCLUSIONS
This type of surgery has never been done in a live animal model before. The pilot results were promising because, within 2 weeks postoperative, there were no signs of any infection or abnormal discharge, and the sutures apposing the skin incision were not compromised. Also, walking functionality was restored, maintained, and similar between the implant and sham groups according to the gait scores. Moreover, the similarity in gait scores between the two groups infer that the presence of the implant does not contribute any more impairment to recovery and walking than the surgery itself. Preliminary histopathological analysis is currently underway and will be included in lateral publications for a more in-depth comparison between the implant and sham groups.

REFERENCES

ACKNOWLEDGEMENTS
This work was supported by NSF CBET 1554739 and DoD CDMRP