CAN LUBRICIN REDUCE THE GLIDING RESISTANCE OF EXTRASYNOVIAL TENDON?
A PRELIMINARY STUDY

*Kutsumi, K; **Jay, GD; +*Amadio, PC; *Zhao, CF; **Cha, CJ; *Zobitz, ME; *Tsubone, T; *An, KN
+*Orthopedic Biomechanics Laboratory, Division of Orthopedic Surgery, Mayo Clinic Rochester, MN. **Brown University, Providence, RI

Introduction
The treatment of severely injured tendons of the hand is still a challenging issue. To reconstruct the function of damaged intrasynovial tendons, autogenous extrasynovial tendon, such as palmaris longus or plantaris tendon, is commonly used as a tendon graft. After tendon grafting, adhesion formation is a major problem. It is known that extrasynovial tendons generate more friction than intrasynovial tendons and that higher friction tendon repairs generate more adhesions than lower friction repairs. Therefore it is reasonable to assume that lower friction might reduce adhesions in tendon grafts. Lubricin is known to be a major lubricant of articular cartilage and a nearly identical compound, superficial zone protein, has been shown to be present in bovine intrasynovial tendons. We hypothesize that lubricin has a role in tendon lubrication, and may be useful in reducing the friction of extrasynovial tendon grafts.

The purpose of this study was to see if lubricin exists in the intrasynovial tendon in a clinically relevant animal model, and to investigate the tendon lubricating ability of lubricin for extrasynovial tendon.

Materials and Methods
A) Gliding resistance test
We tested two extrasynovial canine peroneus longus (PL) tendons. The ipsilateral proximal phalanx and A2 pulley were used for friction testing. The flexor digitorum superficialis was cut at just proximal to the A2 pulley. The flexor digitorum profundus tendon was removed. Lubricin was purified from bovine synovial fluid and diluted to a concentration of 1mg/ml. 0.3 ml of the lubricin solution was applied to the PL tendons before measuring the gliding resistance. The gliding resistance of the tendons was tested against the A2 pulley for 500 cycles, in a saline bath at 37°C as described previously.

The results were then compared to similar testing of canine PL tendon done for a carbodiimide-derivatized hyaluronan (cd-HA)(n=6), and saline (n=6).

B) Lubricin immunohistochemistry in intrasynovial canine tendon
6-µm frozen section of canine FDP tendon were immersed in endogenous peroxidase quenching solution for 20 minutes and then washed with FTA buffer. Following a blocking step in 3% goat serum in FTA buffer the slide was incubated at room temperature for 30 minutes, and then primary peanut agglutinin antibody (pAb 108) was used with a dilution of 1:200. ABC solution (Avidin-Biotin Peroxidase Complex) was applied individually and incubated for 60 minutes at room temperature and washed with FTA buffer. Finally, the slide was immersed in diaminobenzine solution for 5 minutes, and then rinsed quickly in tap water and observed under a light microscope.

Results
A) Gliding resistance test
The gliding resistance of the tendons treated with cd-HA was very similar to that treated with saline (Figure 1). At the beginning of the curve, the gliding resistance increased linearly as the cycles increased and then became almost constant after 300 cycles, at a level more than 8 times as great as that at the beginning. The tendons treated with lubricin showed a different pattern, with gliding resistance about half as much as the other two groups after 200 cycles.

B) Lubricin immunohistochemistry in intrasynovial canine tendon
Lubricin (positive staining) was observed on the epitenon surface of the FDP tendon (Figure 2), as well as around cells within the fibrocartilaginous (compressive) zone of the canine FDP tendon (Figure 3).

Discussion
In this pilot study we investigated the effect of lubricin as a potential lubricant of tendon grafts, and found that it performed better than hyaluronan, our previous benchmark. We also found that lubricin is normally present in canine intrasynovial tendon. In this pilot study, we had insufficient antibody and lubricin to conduct extensive tests, but we believe that the data here is sufficient justification for further work, to identify whether lubricin is normally present in extrasympovial tendon, the effect on friction of removing lubricin from intrasynovial tendon in vitro, and, ultimately, the effect of lubricin as a tendon lubricant in vivo.

Conclusion
Lubricin is present in canine intrasynovial tendon and improves the gliding function of canine extrasynovial tendon in vitro.

Reference