INTRODUCTION:
Although outcomes for flexor tendon surgery have been improved with new regimens of primary repair and postoperative controlled mobilization programs, poor functional outcomes are still common, especially in zone II. In these cases tendon grafts play an important role to restore some hand function, but clinical outcomes after tendon graft are often poor as well. While experimental studies have shown that grafts taken from intrasynovial tendons have better outcomes than extrasynovial grafts, extrasynovial tendons are usually used clinically because autologous intrasynovial tendons are rarely available for use as the tendon graft donor.

Previous studies have also shown that tendon gliding resistance (GR) is an important factor influencing to the outcome of tendon repair. Higher GR results in greater adhesion formation and extrasynovial tendon has a higher GR than intrasynovial tendon. Surface modification of the tendon to improve its gliding ability has been studied using lubricants such as hyaluronic acid, lubricin and phospholipid. Treating the extrasynovial tendon surface with a carbodiimide derivatized hyaluronic acid (cd-HA) and gelatin mixture improves tendon gliding ability in vitro and improves digit function in vivo. Surface modification with lubricin and gelatin has demonstrated further improvement of extrasynovial tendon gliding ability in a canine in vitro model. These lubricating molecules exist in native synovial fluid as well as normal articular cartilage and intrasynovial tendon surfaces and play an important role in joint and tendon lubrication. In this study, we used native synovial fluid as a lubricating material and bound the SF with or without gelatin onto an extrasynovial tendon surface using the carbodiimide reaction. The purpose of this study was to investigate whether such surface modification of extrasynovial tendon would decrease the GR, increase the durability and smoothen the tendon surface in a canine model in vitro.

MATERIALS AND METHODS:
Sixty three peroneus longs (PL) tendons from canine hind legs were used. Three tendons were immediately assessed morphologically by scanning electron microscope (SEM) and served as the normal tendon group. The other sixty tendons were randomly assigned to six experimental groups treated with either a) saline (control), b) carbodiimide activation with 1% 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide hydrochloride (EDC) + 1% N-Hydroxysuccinimide (NHS) (cd), c) with 1% EDC/NHS + 10% gelatin (cd-G), d) with synovial fluid (SF) + 1% EDC/NHS + 10% gelatin (cd-SF-G), e) with SF only, f) with SF + 1% EDC/NHS (cd-SF). The GR was measured up to 1000 cycles of simulated flexion-extension motion. One-way analysis of variance (ANOVA) was used to compare the friction data among the six experimental groups. The tendon surface smoothness after 1000 cycles was also observed qualitatively by SEM.

RESULTS:
GR increased significantly between the first and 1000th cycle in all groups (p<0.05) except the cd-SF-G group. Although there was no significant difference in GR at 1000th cycle between the saline control group and the tendons treated with cd only or SF only, that of the cd-G, cd-SF-G and cd-SF groups was significantly lower than the saline control group (p<0.05). The tendons treated with cd-SF-G showed the lowest GR after 1000 cycles of tendon motion. (Figure 1)

DISCUSSION:
The trend of gliding resistance in each group is shown in Figure 2. The GR of the PL tendons treated with saline, cd only, SF only and cd-SF group roughly quadrupled over the first 500 cycles and then increased at a more gradual rate in the next 500 cycles. The GR of the PL tendon in the cd-G group increased at a much more gradual rate during the 1000 cycles. The GR of the PL tendon treated with cd-SF-G was the most stable during 1000 cycles.

On SEM evaluation, the saline control, cd only, SF only and cd-SF groups appeared to be rough with irregularity arranged collagen bundles on the tendon surface, while the tendon surface treated with cd-SF-G was still smooth and well covered with gelatin between collagen fibers even after 1000 cycles of tendon motion. (Figure 3)

REFERENCES:

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