INTRODUCTION

A simple locking suture is described for securing the end of a small caliber tendon to a bone tunnel or soft tissue. In 1964, Sharrard described using this stitch to secure the iliopsoas tendon to the bone tunnel of the greater trochanter. He referred to it as the clover hitch stitch. Although many different types of suture techniques have been tested for pullout strength, clover hitch stitch has not been studied to the best of our knowledge. This study compares the pullout strength of our locking suture with the modified Kessler stitch and two other simple sutures.

MATERIALS AND METHODS

Seventeen adult dogs weighing about 20-25 Kg were used to extract the 136 flexor digitorum profundus (FDP) tendons from the hind paw. The anatomical structure of the forepaw FDP tendons is similar to that of hindpaw FDP tendons. Tendons from the second, third, fourth and fifth digits were used. The paw was extended to allow full extension of the proximal and interphalangeal joints. The tendon was removed just distal to the A2 pulley, and this represented the physiological excursion of the tendon.

136 tendons were used to measure the breaking strength. A reference point at a distance of 1cm from one end of the tendon was used for the different suture techniques. All techniques used a size 2-0 braided suture. The repair techniques used were:

1. Simple – A simple single strand across the tendon.
2. Double – Two simple strands at 90 degrees to each other, unlocked.
3. Clover hitch – Two strands at 90 degrees, locked (Figure 1).
4. Modified Kessler

Breaking strength of the four suture methods was measured with an Instron 5569 testing machine (Figure 2). Collection of load data was obtained with Merlin software. The machine had load capacities ranging from 2kN to 600kN. One end of the tendon was secured in a clamp and the suture on the opposite end was tied to a hook. Tension was applied through the hook to the tendon at a rate of 20 mm/min until complete disruption of the tendon-suture unit was achieved. The load to produce complete rupture in units of N was obtained in the form of force versus displacement relation. The Merlin software has the ability to record load accurately to 5 decimal places. Before each specimen test, the load and displacement values were calibrated to start from no load and zero displacement to get the accurate data.

RESULTS

We observed that failure of tendon-suture unit was due to tendon failure or knot failure. Breakage of the suture itself was not observed. In the simple suture (Knot 1) the rupture was mainly due to the suture pulling through the tendon substance. In the other techniques the failure was mainly due to tendon breaking.

Ultimate breaking force for the rupture of the tendon-suture unit for 133 tendons was calculated and plotted. The force to rupture was significantly higher in the clover hitch knot as compared to each of the other three (P<.05) (Table 1). The modified Kessler showed a lower breaking force but was greater than the other two. The two more simple suture techniques could not withstand very high tension and were the first to rupture. We also calculated the 95% confidence interval for each of our suture techniques to establish variability.

DISCUSSION

Most work with tendon suture techniques has focused on tendon to tendon repair. Our investigation was concerned with tendon-suture interface strength for clinical situations when the tendon is being fixed to a different site, such as the tendon insertion into the cuboid bone during anterior tibialis tendon transfer procedure for residual congenital clubfoot. Therefore, we tested suture-tendon rupture strength for four different suture techniques. The clover hitch suture had the greatest pullout strength, and this minimize loss of fixation for procedures involving suture passage of tendon through a bone tunnel. In conclusion, the clover hitch suture appears to be an acceptable technique for securing suture to a small caliber tendon to a bone tunnel. Future work in this area could compare the clover hitch suture to still other fixation techniques.

REFERENCES: