ABSTRACT INTRODUCTION:
Complete rupture of the Achilles tendon can be experienced by sedentary patients, mid-age athletes, and diabetes patients [1]. Secure soft-tissue fixation is essential to direct end-to-end repair for acute tendon rupture. Surgical suture for tendon repair can provide good fixation at early healing stage, and achieve well performance of function. However, diabetes could affect patient’s immunity and healing abilities, so the suitability of surgical suture on tendon repair for diabetes patients might be reconsidered. Furthermore, the effect of surgical suture on Achilles tendon repair for diabetes had rarely been reported and interpreted so far. Therefore, the purpose of this study was to investigate the efficacy of Modified Bunnell suture method for Achilles tendon repair in euglycemic and hyperglycemic rats via ankle motion analysis and the Achilles functional index (AFI).

METHODS:
Animals and surgery procedure
100 male Sprague-Dawley rats (Laboratory Animal Center, NCKU, Taiwan) were used in this study. The study and animal care protocols were approved by the Institutional Animal Care and Use Committee (IACUC) of the Laboratory Animal Center at National Cheng Kung University. All the animals with Achilles tendon rupture were randomly assigned into four groups of treatments: (1) Modified Bunnell on normal rats (MN) (2) Control on normal rats (CN) (3) Modified Bunnell suture on hyperglycemic rats (MH) (4) Control on hyperglycemic rats (CH). The Achilles tendon of left hindlimb was completely transected at its midpoint. The Achilles tendon was repaired using modified Bunnell suture method in modified Bunnell group (MN & MH), and without suturing in control group (CN & CH) (Fig 1B). The skin incision was close using 4-0 Nylon suture. The functional condition of rat was evaluated at 4, 7, 14, and 21 days postoperatively.

RESULTS:
In functional evaluation, two-way ANOVA was used to analyze two group factors (suture and hyperglycemia) for each parameter at each time point. The result of AFI (Fig 3) shown that suture affected significantly at all time points (p < 0.05), and hyperglycemia affected significantly after 14 days postoperatively (p < 0.05). In the result of ankle joint angle (Fig 4), the angle at pre-swing was influenced by suture at 4, 7, and 21 days postoperatively (p < 0.05). In addition, hyperglycemia also affected the angle of pre-swing significantly at 7 days postoperatively (p = 0.05). The angle at mid-swing was influenced by suture at 4, 7, and 21 days postoperatively (p < 0.05). The range of motion was influenced by suture at 4, 7, and 7 days postoperatively (p < 0.05). In addition, hyperglycemia also affected the range of motion significantly at 7 and 21 days postoperatively (p < 0.05).

DISCUSSION:
The Achilles functional index was influenced by suture at all time points, and similar results were also found in results of ankle motion analysis. Hyperglycemia affected the Achilles functional index significantly after 14 days postoperatively. In addition, ankle motion of experimental side was also influenced by hyperglycemia after 7 days postoperatively. Therefore, the result shown the Achilles functional index and ankle motion analysis had similar trend in functional condition evaluation.

In conclusion, the hyperglycemic rats had worse Achilles functional condition than normal rats after Achilles tendon rupture which may be caused by the different healing ability. Furthermore, hyperglycemic rats with tendon repair had better functional condition than no repair. The results of this study suggested that the better functional outcome of surgical suture on Achilles tendon repair for hyperglycemic rats.