Mechanical Characterization of Modified Bunnell Suture Method on Achilles Tendon Repair for Hyperglycemic Rats

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ABSTRACT

INTRODUCTION:
Achilles tendon rupture occurs very often in middle age patients and diabetes patients may experience higher risk of rupture [1]. For acute tendon rupture, secure soft-tissue fixation for the direct end-to-end repair is the key issue for good healing. In last year’s ORS, we presented different suture methods for rat Achilles tendon repair and found modified Bunnell suture method provided the best mechanical and functional outcome. However, diabetes could affect patient’s immunity and healing abilities, so there are some doubts about the suitability and the result of surgical suture tendon repair for diabetes patients. The purpose of this study was to investigate the in vivo efficacy and the suitability of Modified Bunnell suture method for Achilles tendon repair in euglycemic and hyperglycemic rats by temporal mechanical strength and stiffness, and histological evaluation.

METHODS:
One hundred male Sprague-Dawley rats weighing 200-250 g (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. The rats 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 0.5 cm proximal to calcaneal insertion with a scalpel blade. Modified Bunnell group was repaired with modified Bunnell suture method (Fig 1A), and Control group was no repair (Fig 1B). The mechanical properties of healing tendon were evaluated at 4, 7, 14, and 21 days postoperatively.

RESULTS:

Induction of hyperglycemia in rats
The model of hyperglycemia was given a single intraperitoneal injection of streptozotocin (60 mg/kg). The induction of hyperglycemia was confirmed 48 hours later by measuring the blood sugar concentration. Hyperglycemia is defined as a random blood glucose level more than 300 mg/dl.

Biomechanical test
Mechanical testing was carried out with LRX (Lloyd Instrument, England). All tendons underwent a test of constant velocity ramp to failure at 10 mm/min. Force-time and displacement-time curves were digitally recorded on an oscilloscope for subsequent post-processing and data analysis. The statistics was analyzed by Two-way ANOVA. Values of p<0.05 were considered statistically significant.

Histological evaluation
The tendon was dissected and fixed in a 4% phosphate buffered paraformaldehyde solution at room temperature. After dehydration in graded ethanol, specimens were embedded in paraffin and cut in 5-μm thick longitudinal sections. The sections were then stained with hematoxylin and eosin stain.

REFERENCES: