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Technical Note

Treatment of acute achilles tendon rupture with the panda rope bridge technique

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ABSTRACT

Introduction: Although nonsurgical methods and many surgical techniques have been developed for repairing a ruptured Achilles tendon, there is no consensus on its best treatment. In this article, a novel minimally invasive technique called the Panda Rope Bridge Technique (PRBT) is described.
Methods: Patient with acute Achilles tendon rupture was operated on in the prone position. The PRBT begin with making the proximal bridge anchor (Krackow sutures in the myotendinous junction), the distal bridge anchor (two suture anchors in the calcaneus bone) and the ropes (threads of the suture anchors) stretched between the anchor sites. Then a small incision was made to debride and reattach the stumps of ruptured tendon. After the surgery, no cast or splint fixation was applied. All patients performed enhanced recovery after surgery (ERAS), which included immediate ankle mobilisation from day 1, full weight-bearing walking from day 5 to 7, and gradually take part in athletic exercises from 8 weeks postoperatively.
Results: PBRT was performed in 11patients with acute Achilles tendon rupture between June 2012 and June 2015. No wound infection, fistula, skin necrosis, sural nerve damage, deep venous thrombosis or tendon re-rupture was found. One year after the surgery, all patients reported 100 AOFAS ankle-hindfoot score points and the mean ATRS was 96.6.
Conclusion: The PRBT is a simple, effective and minimally invasive technique, with no need for immobilisation of the ankle, making possible immediate and aggressive postoperative rehabilitation.

Introduction

Although as the thickest and strongest tendon in human body, the Achilles tendon has been found to be the most commonly ruptured tendon. Rupture often happens to a young population, and incidences have increased in the past decade [1]. The reported annual incidence was 47 for males and 17 for females (per 10,000) in 2001, while the number was 55.2 and 14.7 per 10,000, respectively, in 2012, representing a 22% rise [2].

A diagnosis of acute Achilles tendon rupture is mainly based on palpable gape and a positive Thompson test. Ultrasonography and a magnetic resonance image is helpful for determining the presence of a gap between two stumps, the hematoma volume and the presence of totally discontinuous fibrous bundles. Treatments for acute Achilles tendon ruptures can be divided into surgical and non-surgical approaches. The relative benefits of both approaches remain a subject of debate. Traditionally, non-surgical treatment (cast immobilisation or functional bracing) has been selected for patients with minor ruptures, less active patients, and those with medical conditions that prevent them from undergoing surgery. It is reported that surgical treatment can reduce the risk of re-rupture compared with conservative treatment, but the risks of skin and soft tissue problems are also increased [3]. Although there is still no consensus on the best management for acute Achilles tendon rupture, surgical treatments have shown attraction in healthy and active populations in recent years [1–7]. Many surgical techniques have been developed to reduce soft tissue complications, provide a stronger biomechanical fixation with early healing and short the time from injury to normal activity [7–10]. In this study, a novel surgical technique called the Panda Rope Bridge Technique (PRBT) is described, along with a small case series.

Surgical technique

The study was conducted in accordance with the World Medical Association Declaration of Helsinki. All patients provided informed

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consent and the study was approved by the ethics committee of our hospital.

Each patient received lumbar spinal anaesthesia with a tourniquet applied on the thigh. Patients were operated on in the prone position. The PRBT was performed as illustration (Fig. 1a and b) and the steps were as follows:

(1), making the distal bridge anchor at calcaneus.

One lateral and one medial, two anchors loaded with strong sutures were inserted into the calcaneus bone about 2 cm below the Achilles tendon insertion (Fig. 2A and B). We have generally preferred suture anchors, although interference screws, speed screws and other optional augments can be used to making the distal fixation of threads. In patient who couldn't afford special augment, the distal fixation of threads can be made using a coronal calcaneal tunnel.

(2), making the proximal bridge anchor at myotendinous junction.

At about 10–14 cm proximal to the insertion site of the Achilles tendon, a small incision was made on the surface of the myotendinous junction. The sural nerve was exposed and protected carefully. Threads of the anchors were passed below the crural fascia up to the proximal incision site using ring handle forceps. Three paired Krackow-type locking loops were sutured at the medial and lateral sides of myotendinous junction, respectively (Fig. 2C).

(3), debriding and reattaching the stumps of ruptured tendon.

A short longitudinal incision was made just above the palpable gap of the tendon defect intermediately. The paratenon and peritendinous tissues were longitudinally incised to expose the stumps of ruptured tendon. The seriously damaged tissue and huge hematoma were completely resected (Fig. 2D). Furthermore, the suture threads between the myotendinous junction and calcaneus were tighten at 30° of knee flexion and ankle plantar flexion respectively, and tied when the stumps were appropriately reattached. Then the broken fibre bundles were arranged in parallel rows, and 2–3 stitches with 3-0 USP absorbable threads were made to keep the ruptured tendon stumps in close contact during postoperative exercise. Accurate closure of the peritenon was performed with 3-0 USP absorbable threads (Fig. 2E). Finally, the subcutaneous tissue and the skin were sutured.

(4), implementing enhanced recovery after surgery (ERAS).

After the surgery, no cast or splint fixation was applied. Active mobilisation without weight-bearing was advised immediately postoperatively. Five to seven days after surgery, full weight-bearing walking without crutches was permitted wearing a 30 mm-height heel, which was gradually decreased 5 mm once a week. At 6 weeks postoperatively, muscle strengthening exercises were begun. From 8 weeks postoperatively, the patients were advised to gradually take part in athletic exercises, and return to their previous sports activity when they felt comfortable doing so.

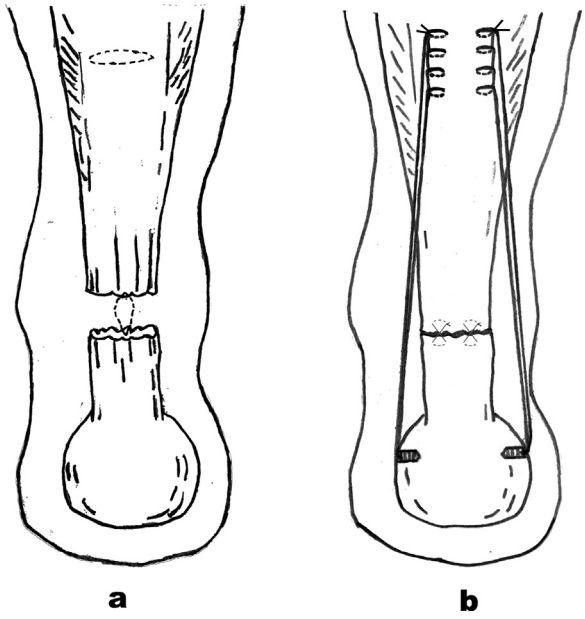

Fig. 1. Illustration of the PRBT. (a) the position of the two small skin incisions. (b) the PRBT includes two bridge anchor sites (Krackow sutures in the myotendinous junction and anchors in the calcaneus) and ropes between them. A few stitches were made to keep the ruptured tendon stumps in close contact during movement of the ankle.

Results

From June 2012 through June 2015, 11 male patients were included and underwent PRBT. Inclusion criteria were as follows: (1) patients with acute Achilles tendon total rupture, which was diagnosed on the basis of Achilles tendon trauma in 3 weeks, a palpable defect and a positive Thompson test; (2) patients who agree to accelerated rehabilitation; (3) patients with no history of previous surgery on the affected lower extremity. All cases were unilateral ruptures, and there were 4 left cases and 7 right cases. The mean age of patients was 30.6 years old (rang: 21–39 years old), and the mean BMI was 24.4 (rang: 20.7–30.0). The mean time between surgery and injury was 3.9 days (rang: 1–8 days).

All the surgeries using PRBT were performed by the same surgeon, who was the senior author. The mean time taken to carry out the PBST was 30 min (rang: 20–40 min). All patients started active mobilisation from day 1 postoperatively and continued to do so. No patients required an immobilisation device during the entire recovery period.

Patients were followed up with a mean period of 30 months (range: 24–54 months). No wound infection, fistula, skin necrosis, sural nerve damage, deep venous thrombosis or tendon re-rupture was found. One year after the surgery, the clinical evaluations were performed. All patients reported an American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score of 100 points. All patients were satisfied with the PBST, and the mean Achilles Tendon Total Rupture Score (ATRS) was 96.3 (range: 92–100).

The mean time between surgery and full weight-bearing walking without crutches was 8.5 days (range: 5–12 days). All patients were self-reliant in managing basic life needs immediately after full weight-bearing walking. The mean time in which patients returned to work was 53 days (range: 30–90 days). The mean time for patients to return to their previous sports activity at the same level or higher was 139.1 days (range: 90–180 days). During follow-up, patients were asked about the most intense sport activities in which they participated after recovery. They reported football, basketball and running. One patient reported the finishing of his first Marathon 2 years after his Achilles tendon surgery.

Discussion

Opinions on open surgery versus percutaneous repair for treatment of acute Achilles tendon ruptures are divided [11]. Gigant et al. compared open surgery with percutaneous repair in acute Achilles tendon rupture patients [12]. The results suggested that there were no significant differences in complications, and both techniques could provide nearly total clinical restoration. Aktas et al. also conducted a study comparing open and minimally invasive repair [8], and reported that minimally invasive repair achieved better results in local tenderness, skin adhesion, scar, tendon thickness and complications. Avina et al. reported similar

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