The Journal of Foot & Ankle Surgery 55 (2016) 965–970

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Comparison of Semi-Invasive "Internal Splinting" and Open Suturing Techniques in Achilles Tendon Rupture Surgery

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ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:
Achilles tendon
elongation
internal splint
isokinetic study
magnetic resonance imaging
surgical technique

ABSTRACT

The goal of the present study was to evaluate the semi-invasive "internal splinting" (SIIS) method for repair of Achilles tendon rupture relative to open repair with Krakow sutures. Efficacy was evaluated based on the clinical and functional outcomes, postoperative magnetic resonance imaging measurements, isokinetic results, and surgical complication rates. Functional measurements included the Thermann and American Orthopaedic Foot and Ankle Society (AOFAS) ankle scores, bilateral ankle dorsiflexion, and plantar flexion measurements. Magnetic resonance imaging was used to compare the bilateral length and thickness of each Achilles tendon. The isokinetic outcomes were evaluated using a Biodex System 3 dynamometer. Of the 45 patients meeting the inclusion criteria, 24 were treated by SIIS and 21 by the open Krackow suture technique. The mean follow-up time for all patients was 43.7 (range 6 to 116) months. In the SIIS group, patients returned to normal daily activities after 7.2 (range 6 to 8) weeks compared with 14.3 (range 12 to 15) weeks in the open surgery group. The AOFAS ankle scores were 93.5 (range 82 to 100) points in the open repair group and 96.2 (range 86 to 100) points in the SIIS group. The Thermann scores were 80.4 (range 53 to 91) points for the open repair group and 87.9 (range 81 to 100) points for the SIIS method. The mean Achilles length on the operated side measured using magnetic resonance imaging was 175.06 (range 110 to 224) mm and 177.76 (range 149 to 214) mm for the open surgery and SIIS groups, respectively. Sensory impairment in the territory of the sural nerve was identified in 1 patient immediately after SIIS surgery, although this defect had completely resolved within 12 months. SIIS yielded better outcomes relative to the open surgery group according to the isokinetic measurements. Taken together, these data indicate the SIIS method for Achilles tendon ruptures performed better in terms of both functional and objective outcomes compared with open surgery.

The Achilles tendon (AT) is the largest and strongest tendon in the body (1). However, despite the strength of this tendon, AT rupture (ATR) has become increasingly common, particularly among those with an active lifestyle. ATR currently affects 2 to 18 people per 100,000 annually, of whom males aged 30 to 50 years are at the greatest risk, with injuries disproportionately affecting the left leg (1–4). The most frequently ruptured part of the AT is located 2 to 6 cm proximally to the calcaneus insertion, where the tendon is avascular and at its thinnest (1,2,5). Additionally, the limited soft tissue coverage of the tendon alters the healing process and can lead to skin complications (6–8).

The best treatment of acute rupture of the AT remains a subject of debate (9). Historically, nonsurgical methods, commonly referred to as conservative treatment, have been preferred, although these methods come with a number of important drawbacks, including greater repeat

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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http://dx.doi.org/10.1053/j.jfas.2016.04.014

rupture rates, atrophy of the calf muscles, decreased muscle strength, and joint stiffness (10–12). More recently, open surgical treatment of ATR has been improved, allowing approximation and strong suturing of the wound, resulting in better healing, lower repeat rupture rates, and early mobilization. However, a series of new problems have emerged as a result of incising vulnerable skin and soft tissue, including wound breakdown, infection, adhesions, and nerve damage, many of which require additional surgery to correct (2,6).

To eliminate the soft tissue complications associated with open techniques, a variety of semi-invasive, minimally open, or percutaneous methods have been developed (6,7). To date, these methods often produce high repeat rupture rates, with a continued risk of sural nerve damage (6,7,10,12). Previously, we reported a semi-invasive internal splinting (SIIS) method for repair of ATR in which the strong sutures used in open techniques were applied in a manner that minimizes damage to the soft tissue (13). In the present study, we compared the results from the first 24 patients treated using SIIS with those of 21 patients treated by open surgical techniques during the same period. Efficacy was evaluated based on clinical and functional outcomes, postoperative magnetic resonance imaging (MRI) measurements, isokinetic results, and surgical complication rates for both SIIS and the open technique for treating acute ART.

Patients and Methods

Patients

A total of 45 patients with ATR were treated using either SIIS or open surgical techniques at the Department of Orthopedics and Traumatology, Kocaeli University Faculty of Medicine (Kocaeli, Turkey), from August 1998 to May 2011 and analyzed retrospectively. Our local ethics committee approved all relevant protocols before initiation of the present study. The inclusion criteria were as follows: a first-time diagnosis of ATR, positive Thompson-Doharty test result, and a palpable defect in the ruptured area confirmed by ultrasonography or MRI. The exclusion criteria included rheumatoid arthritis, systemic lupus erythematosus, local or systemic corticosteroid usage, pregnancy, morbid obesity, radiotherapy or chemotherapy, psychiatric disorders and/or neurologic disease, and previous surgery for ATR.

Surgical Techniques

General or spinal anesthesia was administered for the surgery, and a tourniquet was applied to one third of the proximal femur with the patient in the prone position. All patients were treated with 1 g cefazolin sodium intravenously for bacterial prophylaxis.

The SIIS method was performed as described previously (13). In brief, the technique involves 2 separate incisions 2 to 3 cm from the rupture area. The sural nerve is exposed and protected. Surgery is performed such that the ruptured ends of the tendon are neither exposed nor grasped. A Krackow-type suture is applied to the medial and lateral sides of the tendon proximally with no. 5 Ethibond Excel® (Johnson & Johnson Co., New Brunswick, NJ) suture (Fig. 1) and passed to the distal incision using a tendon passer. Adequate tension is applied to the musculotendinous unit by the suture ends with the foot kept in a plantarflexion position. Locked Krackow sutures are placed on both sides of the distal tendon (Fig. 2). A Thompson test is then performed to confirm the efficacy

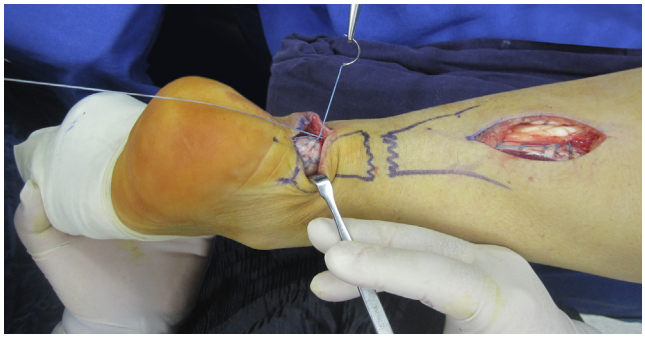

Fig. 2. Proximal sutures tensioned and distal Krackow sutures applied.

of the procedure. The layers are closed, and a dorsal splint is applied to keep the ankle in a 30° plantarflexed position. If the distance of the rupture site is closer than 3 cm to the calcaneal insertion, the distal fixation is secured to the suture using a transcalcaneal tunnel (Fig. 3).

Open repair is performed by exposing the ruptured tendon, after which both ends are secured using the Krackow suturing technique and no. 5 Ethibond Excel® sutures (Johnson & Johnson Co.).

Postoperative Examination

The patients were re-evaluated 9 months after surgery. The study participants were first asked to walk on bare feet over flat ground, and both feet were examined thoroughly. All the patients were then evaluated using the American Orthopaedic Foot and Ankle Society (AOFAS) ankle and Thermann Achilles tendon surgery scoring systems. With both lower knees extended and at full weightbearing, the calf thickness diameter was measured from the tibial tuberosity to a point 10 cm distally on each side. The thigh thickness diameter was measured from the upper limit of the patella to a point 10 cm proximally on each side. The degrees of plantarflexion and dorsiflexion of both ankles were examined using a goniometer. The patients in both groups performed a heel lifting exercise as described by Saxena et al (14), and pain was evaluated.

Postoperative Examination Assessment

The patients were recalled for evaluation 9 months after surgery. They were asked to walk on bare feet over flat ground, and both feet were examined thoroughly. All patients were then evaluated using the AOFAS ankle and the Thermann Achilles tendon surgery scoring systems. With both lower knees extended and at full weightbearing, the calf thickness diameter was measured from the tibial tuberosity to 10 cm distally point on each side, and thigh thickness diameter was measured from the upper limit of the patella to 10 cm proximally point on each side. The degrees of plantarflexion and dorsiflexion of both ankles were examined with the help of a goniometer. Patients in both groups performed a heel lifting exercise described by Saxena et al (14), and the presence of pain was evaluated.

Magnetic Resonance Imaging

MRI was performed with a 1.5 Tesla Intera MRI scanner (Philips Achievea Intera Release, Eindhoven, The Netherlands) using a transmit-receive head coil, with the

Fig. 1. Double incisions made ahead from the rupture area. Proximal Krackow sutures applied first and sutures passed distally.

Fig. 3. Distal fixation performed through calcaneal tunnel if the distal tendon is too short for suture placement without exposing the injured area.