The Journal of Foot & Ankle Surgery xxx (2016) 1–4

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Case Reports and Series

Knotless Repair of Achilles Tendon Rupture in an Elite Athlete: Return to Competition in 18 Weeks

Paul A. Byrne, MEng, MSc, MBChB [1], Graeme P. Hopper, MBChB, MSc, MRCS [2], William T. Wilson, MBChB, BSc (MedSci), MRCS [3], Gordon M. Mackay, MD [4]

[1] *Foundation Doctor, NHS South-East Scotland, Royal Infirmary of Edinburgh, Edinburgh, United Kingdom*
[2] *Specialist Registrar, Trauma and Orthopaedics, NHS Greater Glasgow and Clyde, Queen Elizabeth University Hospital, Glasgow, United Kingdom*
[3] *Specialist Registrar, Honorary Clinical Lecturer, University of Glasgow, Glasgow, United Kingdom*
[4] *Professor, BMI Ross Hall Hospital, Glasgow, United Kingdom*

ARTICLE INFO

Level of Clinical Evidence: 4

Keywords:
Achilles tendon rupture
injury
minimally invasive
rehabilitation
surgical repair

ABSTRACT

Rupture of the Achilles tendon is an increasingly common injury, particularly in physically active males, and current evidence favors minimally invasive surgical repair. We describe the case of a 36-year-old male elite bobsled athlete with complete rupture of the Achilles tendon. He was treated with surgical repair of the ruptured tendon using an innovative, minimally invasive procedure based on an internal bracing concept and was able to undergo early mobilization and aggressive physiotherapy rehabilitation. His recovery was such that he returned to training at 13 weeks postoperatively and participated in an international competition at 18 weeks, winning a World Cup silver medal. He subsequently raced at the 2014 Winter Olympic Games at 29 weeks after surgery. At >2 years since his injury, he has experienced no complications or reinjury. This represents an exceptional recovery that far exceeds the standard expected for such injuries. The use of this technique for athletes could enable accelerated return to sporting activity and attainment of their preinjury activity levels.

The Achilles tendon is the primary plantar flexor of the foot and ankle and is formed by the combined distal tendons of the gastrocnemius and soleus muscles. Despite being the strongest tendon in the body, it is also the most frequently ruptured (1). Rupture of the Achilles tendon is an increasingly common acute injury, most often associated with males in their fourth and fifth decades of life and involved in sport (2–5). The optimal management of such injuries remains controversial, with varying practices in different countries. Surgical repair has been shown to produce quicker recovery to full baseline function, with lower rates of repeat rupture than with conservative management. However, the outcomes are greatly affected by the postoperative management and rehabilitation protocols (3,6). The incidence of patients successfully returning to sport at preinjury levels has varied greatly in published studies (4). Also, of those who do return, the standard recovery time has generally been predicted to require 5 to 9 months (1,7–9).

Case Report

We present the case of a 36-year-old physical training instructor and elite bobsled pilot, who experienced complete rupture of the right Achilles tendon in July 2013 while participating in sprint training in the lead-up to piloting his country's 4-man team at the 2014 Winter Olympics.

Treatment

The patient underwent surgical repair of his Achilles tendon 11 days after injury, with a knotless technique using the InternalBrace™ (Arthrex Inc., Naples, FL) system. This technique involved passing high-strength sutures through the paratenon, proximal to the rupture site, using a specific percutaneous repair jig. These sutures are then passed through the distal stump of the ruptured tendon and anchored into the calcaneus at the level of the distal tendon insertion, creating a knotless repair (Fig.). The sutures were tensioned to restore the musculotendinous length compared with the contralateral limb

Financial Disclosure: Arthrex provided the InternalBrace™ used in the patient described in the present case report.

Conflict of Interest: Dr. Mackay or family members receive royalties from the sale of InternalBrace™ kits. Dr. Mackay also serves as a consultant to Arthrex, Inc., Naples, FL. None of the other authors have any financial disclosures or conflicts of interest.

Address correspondence to: Paul A. Byrne, MEng, MSc, MBChB, NHS South-East Scotland, Royal Infirmary of Edinburgh, Edinburgh EH164SA, United Kingdom.

E-mail address: paul.a.byrne@doctors.org.uk (P.A. Byrne).

1067-2516/$ - see front matter © 2016 by the American College of Foot and Ankle Surgeons. All rights reserved.
http://dx.doi.org/10.1053/j.jfas.2016.07.007

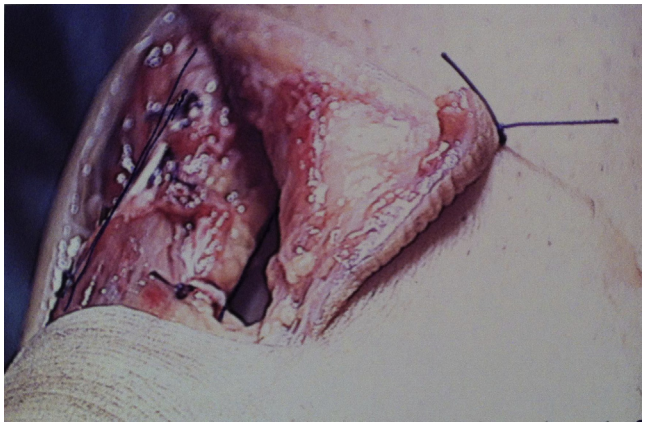

Fig. The repaired Achilles tendon.

(in neutral position), and the paratenon was closed to minimize the risk of soft tissue scarring.

Rehabilitation and Outcome

After surgery, the patient was fitted with a protective moon-boot brace and mobilized with crutches with partial weightbearing (Table). After 7 days, he was able to remove the boot for gentle mobilization with a physiotherapist and moved to full weightbearing in the moon-boot, walking unaided at 4 weeks. At that point, he was free of pain and had regained functional range of motion in the ankle, including full dorsiflexion. No signs of tethering or wound site complications were present, and the calf circumference was only decreased by 1 cm from his preoperative state. Low-level horizontal plyometric work began from week 6 using a Pilates reformer, with the moon-boot fully removed at 8 weeks, as standard. Only minimal differences remained in muscle bulk between his left and right calves. He was able to walk comfortably and had maintained full range of dorsiflexion in the affected ankle. Ultrasonography showed healing and successful remodeling of the tendon. At that point, he began performing dead lifts and low-level dynamic physiotherapy, progressing to vertical plyometric exercises and then running by week 12.

A magnetic resonance imaging scan was arranged at 10 weeks and showed definite tendon continuity, with only a mild degree of fusiform swelling. In contrast, at this stage with traditional repairs, a significant degree of disorganization would usually be expected in the tendon structure.

He returned to bobsled training at week 13 and steadily increased the intensity of his running drills and weights. At week 15, he was training at 80% intensity, and he returned to full international competition at week 18, winning a silver medal at a bobsled World Cup race. He was able to train at full intensity with no significant complications, eventually competing at the Winter Olympics in Sochi, Krasnodar Krai, Russia, 29 weeks after surgery.

At the 12-month follow-up visit, he had experienced no significant complications and had full function, performing at his preinjury level. At 2 years after his injury, he had experienced no further problems.

Table
Summary of recovery progress

Postoperative Period	Progress
Week 1	Able to remove protective moon-boot for physical therapy
Week 4	Full weightbearing in moon-boot
Week 6	Low-level plyometric exercises (horizontal)
Week 8	No longer requiring moon-boot at all; dead lifting 180 kg
Week 9	Low-level dynamic exercises
Week 10	Low-level plyometric exercises
Week 12	Running
Week 13	Low-intensity bobsled training; jumping to knee height
Week 15	Bobsled training at 80% intensity
Week 18	Return to international competition
Week 29	Winter Olympic Games

Discussion

After complete rupture of the Achilles tendon, our patient was treated using a novel knotless repair technique. He made an excellent recovery, returning to sports training at 12 weeks and to world-class elite competition before 5 months.

Achilles tendon rupture is a common injury, whose incidence has been steadily increasing for the past 50 years, from roughly 0.2 per 10,000 to 2 per 10,000 (1,5,10). The epidemiology is strikingly similar across different countries (4,5,10). It shows a bimodal distribution, most common in women >80 years and men in their fourth decade (5). One of the most common mechanisms of injury, in particular, for young males, is in sporting activity, especially those sports involving short, sharp sprints (1,10,11).

The choice of treatment in such injuries has long been controversial, with various operative techniques available, along with conservative management and rehabilitation. Surgery has been reliably shown to produce better results than conservative management with respect to the rates of repeat rupture and tendon elongation (12–14) and is often preferable for young, active individuals (1,11). This advantage, however, comes at the cost of a greater range of possible complications, including soft tissue infection, adhesion formation, venous thromboembolism, and sural nerve injury (12,14).

Operative treatment is commonly divided into open and percutaneous techniques. Various open techniques are available that offer similar success rates (4). However, in recent years, minimally invasive, percutaneous techniques have been developed that offer superior recovery. In particular, they offer a quicker return to sporting activity, better preservation of muscle strength (7,11), and reduced rates of the most common surgical complications such as adhesions and wound infection (15). An athlete's recovery to sporting activity at previous levels depends greatly on the individual concerned and their compliance with rehabilitation. Some clinicians have used a benchmark period of 5 months as a target for patients to have returned to their baseline level of sport. Some studies have shown that >80% of patients achieve this (7,16,17), although other sources have reported a standard recovery period of ≤9 months (1).

After surgery, successful physiotherapy is a key factor in the patient's recovery process; however, rehabilitation protocols vary widely (1). All treatments involve an initial period of protection for the ankle joint, with the ankle kept in a degree of plantarflexion and then gradually extended over time. At one end of the spectrum, complete plaster casting has sometimes been used to immobilize the ankle and render it entirely non-weightbearing, with various iterations of a cast made to gradually extend the ankle from an initial equinus position over a period of 6 to 9 weeks (4). Increasingly, however, practice has tended toward maximizing the functional range of motion as early as possible. Early dynamic functional rehabilitation begins within 2 weeks of surgery, using a brace to protect the ankle but allowing it a full natural range of motion. Meta-analyses have shown that such dynamic rehabilitation, involving early mobilization and loading of the tendon, results in no increase in the incidence of repeat rupture (3,8,9). Moreover, they have shown significant improvement in the rate of recovery of calf strength, with a tendency toward a quicker return to baseline sporting activity when used with partial weightbearing (3). In full weightbearing protocols, the initial