A safe percutaneous repair of Achilles tendon rupture

Emad Zayed, Ahmed Akar, Tarek Abd-El-Ghafar

Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Correspondence to Emad Zayed, MD, Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Darassa Cairo 11633, Egypt. Tel: +20 106 276 2700; fax: +2 02 25128927; e-mail: emadabdou36@yahoo.com

Received 18 October 2017
Accepted 20 December 2017

The Egyptian Orthopaedic Journal
2017, 52:215–220

Background
Although percutaneous repair of Achilles tendon rupture avoids possible complications of open repair as well as conservative treatment, sural nerve injury and re-rupture are the potential complications of percutaneous technique. Here, we describe a surgical technique to minimize the risk of sural nerve injury.
Patients and methods
This study included 22 patients with complete Achilles tendon rupture treated using the presented percutaneous technique within a mean of 8.5 days (2–28 days) of injury. There were 18 men and four women, with a mean age of 34.7 years (25–48 years). Clinical examination, ankle plain radiograph, and Achilles tendon MRI were done for all patients. All patients were followed up for a mean of 26 months (18–40 months).
Results
For 22 patients over the period of follow-up, the mean American Orthopedic Foot and Ankle Society Score was 92.81 (82–100). MRI showed satisfactory healing of the Achilles tendon in all patients at 3 months. All patients had a nearly full range of ankle movement recovery at the latest follow-up. The mean time interval from repair to return to work was 7.54 weeks. There was neither sural nerve injury nor re-rupture observed during the follow-up period.
Conclusion
The presented percutaneous technique is easy and safe, with a low rate of complications. This technique avoids the possible complications of conservative management and open surgery with neither re-rupture nor sural nerve injury, as the percutaneous sutures are not placed in the lateral half of the Achilles tendon proximal to rupture site.

Keywords:
Keywords, Achilles tendon, acute rupture, complications, percutaneous repair, sural nerve

Egypt Orthop J 52:215–220

1110-1148

Introduction

The treatment modalities for Achilles tendon rupture vary from conservative to different surgical treatment options, with no consensus on any of them [1–3].

The main concerns of conservative treatment are the complications of long-term immobilization and re-rupture rate [4], which could be minimized by advances in postoperative rehabilitation programs [5] and functional bracing [1,6].

On the contrary, the main concern of open repair are wound complications [4], which could be minimized by recent advances in minimally invasive techniques [7].

Percutaneous repair of acute Achilles tendon ruptures was first described by Ma and Griffith [8] to avoid the disadvantages of both conservative and open management [4,9].

A major complication of percutaneous repair for acute Achilles tendon rupture is sural nerve affection [10], which might be minimized by the assistance of ultrasound [11] or endoscope [12].

This article presents a series of patients with acute Achilles tendon ruptures treated with percutaneous repair carried out using 4–5 central small incisions over the posterior aspect of the tendon with parallel stab incisions over medial border of the tendon to ensure adequate tendon capture. The purpose of this study is to evaluate the clinical and functional results of percutaneous repair of acute Achilles tendon ruptures and efficacy of this technique in sural nerve protection.

Patients and methods

This study was approved by the Ethical Committee of Al-Azhar University. A total of 22 patients

with complete rupture of the Achilles tendon were treated in Al-Azhar University Hospitals using the presented percutaneous technique. All patients signed an informative consent form. There were 18 men and four women, with a mean age of 34.7 years (25–48 years). The causes of injury were sports activity (12 patients), twist injury (six), falling downstairs (two), and during daily activity (two). Of the 22 patients, 13 were smokers. None of the patients had history of local corticosteroid injection.

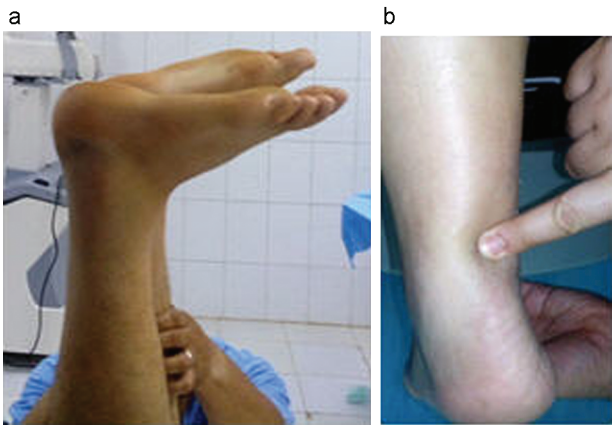
The rupture was diagnosed at the site of rupture a palpable tendon gap (Fig. 1a), positive Thompson test, positive Matles test (Fig. 1b), and loss of plantar flexion in the affected ankle. A diagnosis was confirmed by radiologic evaluation (radiograph and MRI) for all patients. All patients had a complete rupture of the Achilles tendon with a gap less than 3 cm located 3–6 cm proximal to the calcaneal insertion (Fig. 2).

The inclusion criteria were complete rupture of Achilles tendon of not more than 1-month duration with intact skin and intact sensation of the affected limb.

Exclusion criteria were as follows: (a) incomplete rupture of Achilles tendon, (b) chronic rupture exceeding 1-month duration, (c) sensory impairment of the affected limb, (d) bony avulsion of calcaneal tuberosity, (e) history of recent local corticosteroid injection, and (f) re-rupture of the Achilles tendon.

The percutaneous tendon repair was done within a mean of 8.5 days (2–28 days) of injury. The mean follow-up was 26 months (18–40 months).

Figure 1

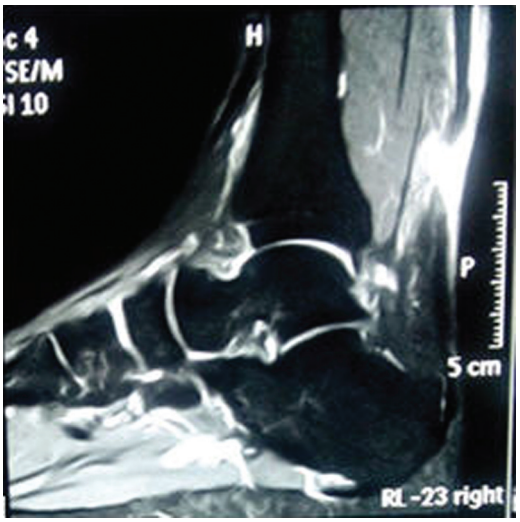


(a) Positive Matles test result. (b) Palpable tendon gap.

Operative technique

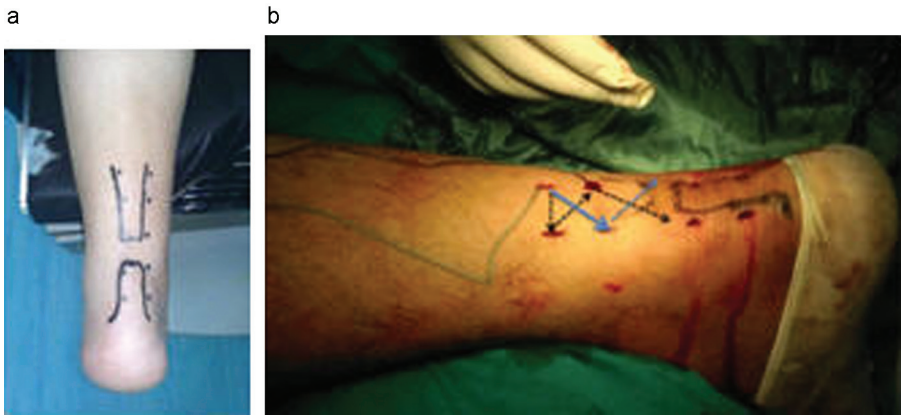
All patients underwent surgery under spinal anesthesia without tourniquet. Patients were placed in prone position with free ankle and foot for easily mobilization. After detecting the site of rupture, skin incision markings were done along the posterior aspect of the Achilles tendon (Fig. 3a). Leg and foot were prepared and draped. Over the posterior aspect of the tendon, 4–5 stab incisions were done just medial to the medial border of the tendon with parallel central stab incisions proximal to rupture gap, with the most distal stab incision deviated laterally to ensure adequate tendon capture (avoiding the lateral border of the Achilles tendon proximal to rupture site to minimize the risk of sural nerve injury). A curved hemostat of adequate size was used to define the way to the tendon, so we can avoid skin and subcutaneous dimpling after suture tying and also avoid the possibility of sural nerve penetration. Percutaneous suturing was done using no. 5 Ethibond (Ethicon, Somerville, NJ) suture on double straight cutting needles (sufficiently long and rigid to penetrate the tendon). The needle was inserted transversely through the proximal stab incisions starting from midline stab incision to medial stab incision. Then, the second needle was advanced obliquely to the opposite second medial stab incision. The suture was advanced through the proximal tendon stump to the distal stump of the tendon (Fig. 3b). The suture was secured to the distal tendon by transverse advancement of the needle. Finally, the suture ends were tied with the help of knot pusher with the ankle in plantar flexion close the rupture gap. Each stab incision was closed with single stitch by no. 3–0 nylon sutures.

Figure 2



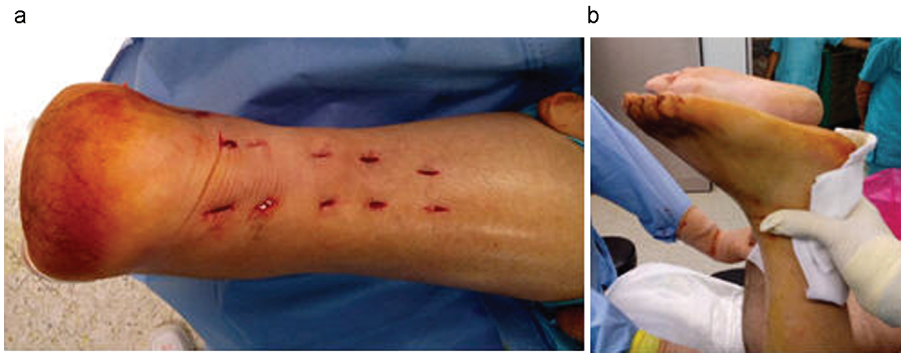
MRI of the Achilles tendon with complete rupture and a tendinous gap less than 3 cm located ~5 cm proximal to the calcaneal insertion of the tendon.

Figure 3



(a) Skin incision markings along the posterior aspect of the Achilles tendon. (b) Advancement of the suture through the proximal stump to the distal stump of the tendon.

Figure 4



Intraoperative clinical evaluation of tendon repair. (a) Negative Thompson test. (b) Negative Matles test.

Intraoperative clinical evaluation of ankle range of motion, Thompson test, and Matles test (Fig. 4) were done for all patients.

Postoperative care and follow-up

Immobilization was done for two weeks in. in anterior below knee splint in maximum plantar flexion. This was followed by cast in mild plantar flexion for 2 weeks. Then finally, a below knee walking cast applied with ankle in plantigrade position for 2 weeks. After 6 weeks, gradual protected weight bearing, gradual increase in ankle range of motion, and calf strengthening exercise were initiated. Routine clinical follow-up was performed at 2, 4, and 6 weeks. MRI was done at 3 months for all patients, and the clinical follow-up was completed at 6, 9, 12, 18, and 24 months.

American Orthopedic Foot and Ankle Society Score (AOFAS) [13] was used for functional evaluation [the ankle–hindfoot scale consists of nine items scored together for a total of 100 points, which are distributed over three categories: pain (40 points), function (50 points), and alignment (10 points)]. Thompson test, double heel rise test, and the single heel rise test were recorded. Patients' return to work and complications were recorded.

Results

Average time of percutaneous repair of Achilles tendon rupture was 20 min (15–30 min). Period of hospitalization was 1–2 days.

The mean follow-up was 26 months (18–40 months). Functional outcomes were recorded at the 18-month postoperative visit for all 22 patients. The mean American Orthopedic Foot and Ankle Society Score was 92.8 (82–100) (Table 1).

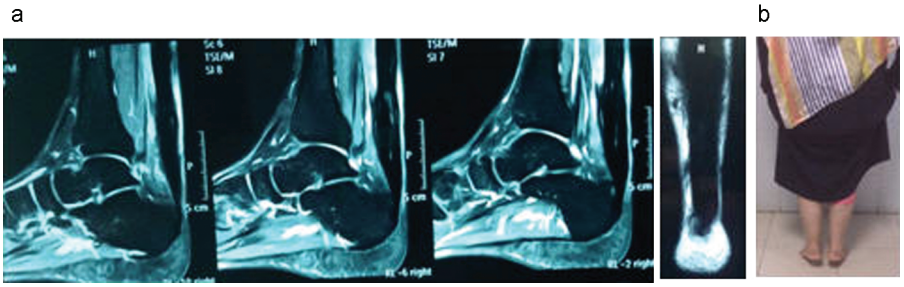
The time interval from repair to return to work was 5–12 weeks, with a mean time of 7.54 weeks. The time interval from repair to return to sports was 16–28 weeks, with a mean time of 20 weeks.

Table 1 Results of current study

Patient nos	Age (years)	Sex	Smoking	Time elapsed since trauma (days)	Return to work (weeks)	AOFAS	Complications
1	31	Male	Nonsmoker	5	6	100	–
2	48	Female	Nonsmoker	28	12	85	–
3	36	Male	Smoker	21	10	87	Nonsignificant skin dimpling at site of stab incisions
4	28	Male	Smoker	16	7	90	–
5	32	Male	Smoker	7	6	97	–
6	26	Male	Nonsmoker	7	5	100	–
7	34	Male	Nonsmoker	6	8	97	–
8	40	Male	Smoker	4	9	87	–
9	36	Male	Smoker	18	9	97	–
10	45	Female	Nonsmoker	9	11	82	Stitch irritation related to the distal wound improved with time
11	38	Male	Smoker	7	8	87	–
12	36	Male	Smoker	4	6	100	–
13	25	Male	Smoker	14	7	90	–
14	36	Male	Smoker	8	8	97	–
15	41	Female	Nonsmoker	3	9	85	Occasional posterior ankle pain
16	38	Male	Smoker	2	8	87	–
17	31	Male	Nonsmoker	4	6	100	–
18	33	Male	Smoker	3	8	97	–
19	26	Male	Smoker	2	5	100	–
20	39	Female	Nonsmoker	11	7	87	–
21	29	Male	Nonsmoker	5	5	100	–
22	37	Male	Smoker	3	6	90	–
Mean	34.7	–	–	187/22 (8.5)	166/22 (7.54)	2042/22 (92.81)	–

AOFAS, American Orthopedic Foot and Ankle Society Score.

Figure 5



(a) MRI showed satisfactory healing of the Achilles tendon at 3 months. (b) Double heel rise test.

MRI showed satisfactory healing of the Achilles tendon in all patients at 3 months (Fig. 5a). At the 18Th-month postoperative visit for all the patients, the ankle ranges of motion returned to normal with respect to the normal side (Fig. 5b). Additionally, single heel rise and tiptoe walking were possible, with negative Thompson test result.

One patient developed nonsignificant skin dimpling at site of stab incisions, and another patient developed a distal stitch knot irritation, which was improved with time. There was neither sural nerve injury nor re-rupture observed during the follow-up period. In this series, no deep vein thrombosis, complex regional pain syndrome, nor infection was observed.

Discussion

The variable anatomical course of sural nerve makes it vulnerable to injury during percutaneous suturing of recent Achilles tendon rupture. The sural nerve during its course crosses the lateral border of Achilles tendon at variable distances from tendon insertion (5.7 cm [14], 9.8 cm [15], or 11.8 cm [16]). Distally the sural nerve passed lateral to the Achilles tendon insertion about 14.3 mm in a cadaveric study [14] and 18.8 mm in another one [15].

Ma and Griffith [8] in their original percutaneous repair were using three stab incisions on each side of the Achilles tendon with neither injury to sural nerve nor re-rupture. Many studies (Table 2) reported sural nerve affection in percutaneous repair, with overall rate of 7.29% (28 out of 384 patients) [8,12,17–26]. A cadaveric study by Hockenbury and Johns [27] found that proximal sutures of the original technique entrap the sural nerve in three of five specimens.

To overcome the possibility of sural nerve injury the lateral half of the Achilles tendon should be spared from percutaneous sutures [15] or direct visualization of the sural nerve by enlarging the lateral stab incisions of the original technique to ~2 cm [19,22].

In the current series, to avoid the potential complication of sural nerve injury, we use four to five stab incisions just medial to the medial border of the Achilles tendon with parallel central stab incisions (not lateral) proximal to rupture site, with the most distal stab incision deviated laterally to ensure adequate tendon capture.

Later on, Makulavicius *et al.* [28] in their cadaveric study proposed that medialization of standard percutaneous repair technique may have a positive effect on sural nerve protection.

In our series, there were no sural nerve injuries, and this is consistent with Webb and Bannister [26] (only three central posterior stab incisions were used to percutaneously repair the Achilles tendon without incidence sural nerve injury). In Soubeyrand *et al.* [11], an ultrasound was used as an intraoperative guide to avoid sural nerve penetration and to judge stump approximation. This finding is in contrast to endoscopically assisted percutaneous repair described by Fortis *et al.* [12], in which sural neuralgia occurred in two of 20 patients undergoing minimally invasive repair techniques by Achillon device, with a relatively high risk of sural nerve injury [29].

In our series, no tendon re-ruptures with adequate tendon healing at 3 months were observed. This might be attributed to the adequate tendon capture by increasing the number of stab incisions (8–10 stab incisions on both sides). This coincident with Robert *et al.* [25] and Sirový and Carda [24]. Re-rupture occurred in two of 60 patients undergoing percutaneous repair in the study of Jean-Louis *et al.* [23]. The overall rate of re-rupture from many reports [8,12,17–26] was 2.6% (10 of 384 patients) (Table 2).

Deep venous thrombosis does not occur in our series, and this is might be attributed to early mobilization in anterior below knee slab and accelerated rehabilitation programs. Deep venous thrombosis has occurred in different modalities of management, whether conservative [3], open [24], or percutaneous [19,24,30].

Jean-Louis *et al.* [23] and Robert *et al.* [25] consider that 2 weeks is the maximum time interval that should be accepted after tendon rupture if percutaneous technique is to be used. In the current study, the mean time interval between injury and percutaneous repair was 8.5 days (2–28 days), with four patients operated after more than 2 weeks and one of them was operated upon 4 weeks from injury (Table 1). However, we cannot rely on those four patients to make a solid conclusion that justifies the use of the percutaneous technique more than two weeks after injury.

Table 2 Reported rates of sural nerve injury and tendon re-rupture in percutaneously treated Achilles tendon rupture

References	Number of cases	Sural nerve injury	Re-rupture
Bradley and Tibone [17]	12	–	2
Carmont *et al.* [18]	49	4	1
Majewski *et al.* [19]. (nonexposure group)	46	8	1
Haji *et al.* [20]	38	4	1
Ma and Griffith [8]	18	–	–
Rowley and Scotland [21]	10	1	–
Klein *et al.* [22]	38	5	3
Jean-Louis *et al.* [23]	60	–	2
Fortis *et al.* [12]	20	2	–
Sirový and Carda [24]	42	3	–
Robert *et al.* [25]	14	1	–
Webb and Bannister [26]	37	–	–
Total	384	28	10

Conclusion

The presented percutaneous technique is easy and safe, with a low rate of complications. This technique avoids the possible complications of conservative management and open surgery with neither re-rupture nor sural nerve injury, as the percutaneous sutures are not placed in the lateral half of the Achilles tendon proximal to the rupture site.

Points for further assessment

This may be a starting point to investigate the possibility of percutaneous repair of ruptured Achilles tendon after 1-month duration and after local corticosteroid injection.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Soroceanu A, Sidhwa F, Aarabi S, Kaufman A, Glazebrook M. Surgical versus nonsurgical treatment of acute Achilles tendon rupture: a meta-analysis of randomized trials. J Bone Joint Surg Am 2012; 94:2136–2143.

2 Karabinas PK, Benetos IS, Lampropoulou-Adamidou K, Romoudis P, Mavrogenis AF, Vlamis J. Percutaneous versus open repair of acute Achilles tendon ruptures. Eur J Orthop Surg Traumatol 2014; 24:607–613.

3 Holm C, Kjaer M, Eliasson P. Achilles tendon rupture treatment and complications: a systematic review. Scand J Med Sci Sports 2015; 25:1–10.

4 Amendola A. Outcomes of open surgery versus nonoperative management of acute achilles tendon rupture. Clin J Sport Med 2014; 24:90–91.

5 Al-Mouazzen L, Rajakulendran K, Najefi A, Ahad N. Percutaneous repair followed by accelerated rehabilitation for acute Achilles tendon ruptures. J Orthop Surg (Hong Kong) 2015; 23:352–356.

6 McCormack R, Bovard J. Early functional rehabilitation or cast immobilisation for the postoperative management of acute Achilles tendon rupture? a systematic review and meta-analysis of randomised controlled trials. Br J Sports Med 2015; 49:1329–1335.

7 Hsu AR, Jones CP, Cohen BE, Davis WH, Ellington JK, Anderson RB. Clinical outcomes and complications of percutaneous achilles repair system versus open technique for acute achilles tendon ruptures. Foot Ankle Int 2015; 36:1279–1286.

8 Ma GWC, Griffith TG. Percutaneous repair of acute closed ruptured Achilles tendon: a new technique. Clin Orthop 1977; 128:247–255.

9 Maes R, Copin G, Averous C. Is percutaneous repair of the Achilles tendon a safe technique? a study of 124 cases. Acta Orthop Belg 2006; 72:179–183.

10 Ververidis AN, Kalifis KG, Touzopoulos P, Drosos GI, Tilkeridis KE, Kazakos KI. Percutaneous repair of the Achilles tendon rupture in athletic population. J Orthop 2015; 13:57–61.

11 Soubeyrand M, Serra-Tosio G, Campagna R, Molina V, Sitbon P, Biau DJ. Intraoperative ultrasonography during percutaneous Achilles tendon repair. Foot Ankle Int 2010; 31:1069–1074.

12 Fortis AP, Dimas A, Lamprakis AA. Repair of achilles tendon rupture under endoscopic control. Arthroscopy 2008; 24:683–688.

13 Kitaoka HB, Alexander IJ, Adelaar RS, Nunley JA, Myerson MS, Sanders M. Clinical rating systems for the ankle-hindfoot, midfoot, hallux, and lesser toes. Foot Ankle Int 1994; 15:349–353.

14 Porter KJ, Robati S, Karia P, Portet M, Szarko M, Amin A. An anatomical and cadaveric study examining the risk of sural nerve injury in percutaneous Achilles tendon repair using the Achillon device. Foot Ankle Surg 2014; 20:90–93.

15 Webb J, Moorjani N, Radford M. Anatomy of the sural nerve and its relation to the Achilles tendon, Foot Ankle Int 2000; 21:475–477.

16 Kammar H, Carmont MR, Kots E, Laver L, Mann G, Nyska M, Mei-Dan O. Anatomy of the sural nerve and its relation to the Achilles tendon by ultrasound examination. Orthopedics 2014; 37:298–301.

17 Bradley JP, Tibone JE. Percutaneous and open surgical repairs of Achilles tendon ruptures: a comparative study. Am J Sports Med 1990; 18:188–195.

18 Carmont MR, Heaver C, Pradhan A, Mei-Dan O, Gravare Silbernagel K. Surgical repair of the ruptured Achilles tendon: the cost-effectiveness of open versus percutaneous repair. Knee Surg Sports Traumatol Arthrosc 2013; 21:1361–1368.

19 Majewski M, Rohrbach M, Czaja S, Ochsner P. Avoiding sural nerve injuries during percutaneous Achilles tendon repair. Am J Sports Med 2006; 34: 793–798.

20 Haji A, Sahai A, Symes A, Vyas JK. Percutaneous versus open tendo Achillis repair. Foot Ankle Int 2004; 25:215–218.

21 Rowley DI, Scotland TR. Rupture of the Achilles tendon treated by a simple operative procedure. Injury 1982; 14:252–254.

22 Klein W, Lang DM, Saleh M. The use of the Ma-Griffith technique for percutaneous repair of fresh ruptured tendo Achillis. Chir Organi Mov 1991; 76:223–228.

23 Jean-Louis R, Thomas N, Octavio L, Emmanuel G, Wael D. Percutaneous suture of acute Achilles tendon rupture: a study of 60 cases. Acta Orthop Belg 2010; 76:237–242.

24 Sirový M, Carda M. Open vs. percutaneous suture repair of the subcutaneous Achilles tendon rupture. Rozhl Chir 2007; 86:594–599.

25 Robert EF, John H, James H. Percutaneous Achilles tendon repair. Am J Sports Med 1993; 21:724–727.

26 Webb JM, Bannister GC. Percutaneous repair of the ruptured tendo Achillis. J Bone Joint Surg Br 1999; 81:877–880.

27 Hockenbury RT, Johns JC. A biomechanical in vitro comparison of open versus percutaneous repair of tendon Achilles. Foot Ankle 1990; 11:67–72.

28 Makulavicius A, Martin Oliva X, Mazarevicius G, Klinga M, Uvarovas V, Porvaneckas N, *et al.* Comparative anatomical study of standard percutaneous and modified medialised percutaneous Bunnell type repair for artificial Achilles tendon rupture: positive effect of medialisation of the stitches with lower risk of sural nerve injury. Folia Morphol (Warsz) 2016; 75:53–59.

29 Aibinder WR, Patel A, Arnouk J, El-Gendi H, Korshunov Y, Mitgang J, Uribe J. The rate of sural nerve violation using the Achillon device: a cadaveric study. Foot Ankle Int 2013; 34:870–875.

30 Henríquez H, Muñoz R, Carcuro G, Bastías C. Is percutaneous repair better than open repair in acute Achilles tendon rupture? Clin Orthop Relat Res 2012; 470:998–1003.