



Early rehabilitation after open repair for patients with a rupture of the Achilles tendon



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ARTICLE INFO

Article history:
Accepted 24 April 2017

Keywords:
Achilles tendon
Open repair
Rehabilitation
Rupture

ABSTRACT

Purpose: As outdoor activities participation increase, Achilles tendon rupture incidence also tends to increase. There are a number of treatment and rehabilitation options for a ruptured Achilles tendon. However, the optimal rehabilitation protocols are still under debate. The purpose of this study is to determine whether early rehabilitation is more effective than conventional rehabilitation.

Methods: Medical records of 56 patients who had been treated with open repair after a ruptured Achilles tendon were retrospectively reviewed. 24 patients were treated postoperatively with below knee cast immobilization for four weeks, and they started tolerable weight-bearing rehabilitation at four weeks' follow-up. The remaining 32 patients were managed postoperatively with short leg splint immobilization for two weeks and started the tolerable weight-bearing at two weeks' follow-up. We evaluated the patients several times to identify when the single heel raise was possible and measured the American Orthopedic Foot and Ankle Society (AOFAS) scores and Achilles tendon total rupture scores (ATRS) as a functional outcome.

Results: The single heel raise test was positive in all patients at the last assessment. But there were no statistically significant differences between the groups ($p=0.137$). The patients in the Cast group took significantly more time to return to work than did the patients in the Splint group ($p=0.032$). And AOFAS scores and ATRS were slightly higher in the Splint group than in the Cast group. There were statistically significant differences ($p=0.042$, $p=0.028$) between the two groups.

Conclusion: The early rehabilitation did not lead to greater endurance, but it showed better results in the return to work and the Achilles functional score. Early rehabilitation after open repair for patients with a ruptured Achilles tendon is helpful for functional recovery.

Type of study / Level of evidence: Therapeutic, Level III.

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Introduction

The Achilles tendon is one of the strongest tendons in the human body. It experiences the highest loads of any tendon in the body, with tensile loads reaching up to 10 times body weight during sports activities [1]. Ruptured Achilles tendons occur in 6–18 per 100,000 people each year; it is a relatively common injury [2,3] that typically affects 30- to 50-year-old men who play enjoying active sports [2]. As leisure and sports participation increase, Achilles tendon rupture incidence also tends to increase.

The most common mechanism of the Achilles tendon injury is a rapid eccentric contraction of the gastrocnemius and soleus muscles during sports activities. This injury can be but is not necessarily associated with a pre-existing tendinopathy [4,5];

accordingly, the injury can be divided into acute or chronic. Some patients may experience this injury by traumatic lacerations. There are a number of treatment options for a ruptured Achilles tendon depending on whether the injury is acute or chronic and on the injury site. However, the optimal treatments and rehabilitation protocols for Achilles tendon rupture are still under debate [6].

We analyzed the outcomes of early rehabilitation by measuring the first time that single heel raise was possible and the functional scores for patients who underwent same surgery but had different rehabilitation protocols. The purpose of this study is to determine whether early rehabilitation is more effective than conventional rehabilitation with these results.

Material and methods

From March 2011 to March 2015, we retrospectively analyzed 78 patients who had been treated with open repair after a ruptured Achilles tendon; the inclusion criterion was an isolated, primary,

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and acute total rupture of the Achilles tendon; we defined an acute rupture as less than two weeks [7] from injury to operation. We excluded nine patients because of delayed presentation (over two weeks), re-rupture, or previous Achilles tendon surgery, and we also excluded six patients who had partial rupture by traumatic lacerations. Another seven patients had the injury combined with a fractured tibia or a large defect of the Achilles tendon that required tendon lengthening or transfer.

Finally, 22 patients were excluded and 56 patients were included in this study after Institutional Review Board approval (Fig. 1). There were 46 males and 10 females, with a mean age of 39 years (Range; 13–69) and a mean time between injury and surgery of 3.5 days (Range; 0–9).

48 of the 56 patients had injured themselves during activities; such as football, badminton, tennis, gymnastics, and kendo. 7 patients had been injured by falling and one was injured by a piece of broken glass.

Surgical procedure

In all cases, the corresponding author and colleagues performed the surgeries. We approached the ruptured tendon by a posterior longitudinal incision along the medial border of the Achilles tendon in all patients. We continued the dissection into the paratenon, and full-thickness flaps were reflected to expose the ruptured tendon. We used two double-stranded Krackow sutures (Outside by Ethibond and Inside by PDS) to appose the tendon ends and then supplemented these with interrupted Vicryl circumferential sutures. We sutured over the paratenon repair with Vicryl and closed the skin with interrupted fine nylon mattress sutures.

Postoperative management

We divided all patients into two groups according to the postoperative rehabilitation protocols. Of these 56 patients, 24 were treated postoperatively with below knee cast immobilization for four weeks after the surgery, and they started tolerable weight-bearing rehabilitation in a functional brace at four weeks' follow-up. The remaining 32 patients were managed postoperatively with short leg splint immobilization for two weeks and started the tolerable weight-bearing in a functional brace (Fig. 2) at two weeks' follow-up.

Except for the initial immobilization method and period, the residual rehabilitation protocols were the same in the two groups. During the period of maintenance with a cast or splint, the ankle was immobilized in a non-weight-bearing position of natural plantar flexion. After the patients had switched to the functional



Fig. 2. Functional brace after the removal of the cast or splint. Common in both groups.

brace, tolerable weight-bearing and ankle joint motion from full plantar flexion to -20° dorsiflexion were permitted. The dorsiflexion angle of the ankle joint increased 10° per a week, and then the patients started the single leg stance and both the single and double heel raise when it was possible (Table 1).

At postoperative six weeks in the cast group and four weeks in the splint group, the patients were allowed to perform full weight-bearing as tolerated, using crutches and a functional brace. Additionally, the ankle joint was permitted to the full range of motion in addition to the plantar strengthening exercises and distraction exercise of the muscles around the Achilles tendon using a rubber band. As muscle strength was recovered progressively, all patients necessarily started the single leg stance and both the single and double heel raise.

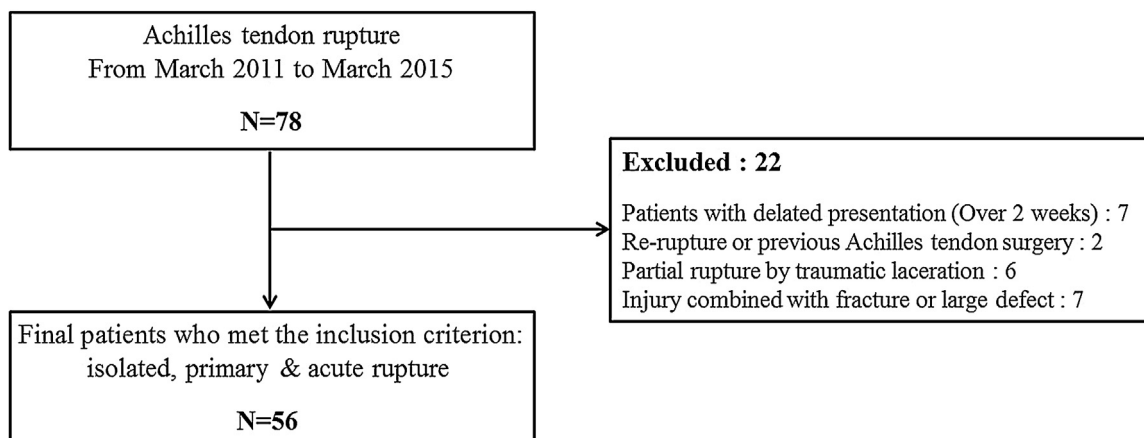


Fig. 1. Flow chart. The progress of patient selection according to our inclusion and exclusion criteria.

Table 1
Rehabilitation protocols in the two groups.

	Cast Group	Splint Group
Number of Patients	24	32
Period of Immobilization	4 weeks after the surgery	2 weeks after the surgery
Common protocols	Tolerable weight-bearing in a functional brace ROM from Full plantar flexion to -20° dorsiflexion Increasing of dorsiflexion angle: 10° per a week Single leg stance and Double heel raising if possible	
Full weight-bearing	6 weeks after the surgery (as tolerated)	4 weeks after the surgery (as tolerated)
Common protocols	Full range of motion Plantar strengthening exercises and Distraction exercise Single heel raising exercise	

We evaluated the patients at 2, 4, 6, 8, 12, and 24 weeks and at 1 year to identify when the single heel raise was possible. We considered it possible when the patients could raise their heels off the floor and sustain them over two fingers in height for 3 s [8].

If the single heel raise was impossible at four months after surgery, additional follow-up was performed every month. If it was possible at four or five months after surgery, the next follow-up was six months after; in all cases, final follow-up was at one year after surgery.

By measuring the American Orthopedic Foot and Ankle Society (AOFAS) scores [9] and Achilles tendon total rupture scores (ATRS) through an interview and physical examination at 12 months after surgery, we evaluated the final clinical results.

Statistical analysis

We statistically analyzed the clinical results in the two groups to compare the range of motion in the ankle joint, the first time it was possible to do the single heel raise exercise, the time to return to work, and the functional scores including the AOFAS and ATRS. We compared with values using the Mann-Whitney *U* test and defined statistical significance as a *p* value <0.05. We used the statistical software R (v 3.1.0, Comprehensive R Archive Network, GNU General Public License) for the analyses.

Results

Range of motion

In both groups, most patients had no significantly different range of motion in the ankle joint compared with that in the uninjured ankle; maximum active plantar flexion was 46.4° in the Cast group and 49.7° in the Splint group, and dorsiflexion was 18.4° in the Cast group and 19.1° in the Splint group. There were also no statistically significant differences between the two groups (Table 2).

Endurance

The single heel raise test was positive in all patients at the last assessment. The first possible time to do the single heel raise was 14 + 2 weeks after surgery in the cast group and 12 + 3 weeks in the

splint group, but there were no statistically significant differences (*p* = 0.137) between the groups (Table 2).

Return to work

The patients in the Cast group took significantly (*p* = 0.032) more time to return to work than did the patients in the Splint group; The mean period was 9 + 3 weeks (Range; 2–18 weeks) in the cast group and 5 + 2 weeks (Range; 1–16 weeks) in the splint group (Table 2). Most patients returned to their original workplace, but one patient who was a Taekwondo athletes had to change his job because of discomfort during sports activity.

Functional score

At final follow-up 12 months after surgery, AOFAS and ATRS scores in all patients were an average of 93 points and 81 points, respectively. In the cast group, the AOFAS and ATRS were 89 points and 79 points, respectively, and the scores in the splint group were slightly higher, 93 points and 81 points, respectively. There was statistically significant differences (*p* = 0.042, *p* = 0.028) between the two groups (Table 2).

Discussion

The treatments for a ruptured Achilles tendon are both surgical and non-surgical. Because there are a number of reports that conservative treatment can cause complications such as re-rupture, weakness of plantar flexion force, and stretching of the Achilles tendon beyond its capacity [6,10–13] rigid surgical suture treatment has come to be preferred in recent years. There are a variety of ways to repair the Achilles tendon surgically from classical open repair to mini-open or percutaneous repair. Henríquez et al. reported that there were no significant differences between open and percutaneous repair [14], and Fortis et al. reported that percutaneous repair with endoscopy was a useful and safe technique with good outcomes [15]. However, open repair through posterior longitudinal incision along the medial border of the Achilles tendon is still widely used, especially the Krackow suture [16]. We used this classical medial longitudinal incision and Krackow suture in this study.

Postoperative treatment of Achilles tendon repair usually entailed limiting weight bearing and immobilization in a cast

Table 2
Mean values for the functional scores in both groups.

	Functional Measurements					
	Plantar flexion (°)	Dorsiflexion (°)	SHR (weeks)	Return to work (weeks)	AOFAS	ATRS
Cast Group	46.4 [2.3]	18.4 [1.2]	14 + 2 [1.7]	9 + 3 [1.8]	89 [3]	79 [4]
Splint Group	49.7 [0.5]	19.1 [0.9]	12 + 3 [1.3]	5 + 2 [1.3]	93 [2]	81 [2]
<i>p</i> Value	.225	.137	.137	.032	.042	.028

Data represent the mean [SD] (Mann-Whitney *U* test).

for six weeks [17], but long-term immobilization has the disadvantage that it can lead to complications such as joint stiffness and tendon adhesion; recent studies have reported good results from early rehabilitation after Achilles rupture surgery. Maffulli et al. reported that early weight bearing and mobilization resulted in shortening the time needed for rehabilitation [18].

In this study, we also used two kinds of rehabilitation methods to analyze whether early rehabilitation leads to better results. Although the early rehabilitation did not lead to greater endurance, it showed better results in the return to work and the Achilles functional score.

The limitations of this study are that the number of patients was relatively small and it was a retrospective study. Further prospective studies are needed to confirm these findings. Additionally, we did not compare the experimental treatments with conservative treatment and other surgical or rehabilitation methods. Moreover, a number of factors such as incomplete recovery of tension after surgery and secondary gains associated with insurance companies can lead to inaccurate results.

Conclusions

In conclusion, early rehabilitation after open repair for patients with a ruptured Achilles tendon is helpful for functional recovery. Our method can be one of the effective rehabilitation options for patients with an isolated, primary, and acute total rupture of the Achilles tendon.

Conflicts of interest

None.

References

- [1] O'Brien M. The anatomy of the Achilles tendon. *Foot Ankle Clin* 2005;10(2):225–38.
- [2] Leppilahti J, Puranen J, Orava S. Incidence of Achilles tendon rupture. *Acta Orthop Scand* 1996;67:277–9.
- [3] Maffulli N, Waterston SW, Squair J, Reaper J, Douglas AS. Changing incidence of Achilles tendon rupture in Scotland: a 15-year study. *Clin J Sport Med* 1999;9:157–60.
- [4] Riley G. Tendinopathy from basic science to treatment. *Nat Clin Pract Rheumatol* 2008;4:82–9.
- [5] Tallon C, Maffulli N, Ewen SW. Ruptured Achilles tendons are significantly more degenerated than tendinopathic tendons. *Med Sci Sports Exerc* 2001;33:1983–90.
- [6] Jacobs D, Martens M, Van Audekercke R, Mulier JC, Mulier FR. Comparison of conservative and operative treatment of Achilles tendon rupture. *Am J Sports Med* 1978;6:107–11.
- [7] Lansdaal JR, Goslings JC, Reichart M, Govaert GA, van Scherpenzeel KM, Haverlag R, et al. The results of 163 Achilles tendon ruptures treated by a minimally invasive surgical technique and functional aftertreatment. *Injury* 2007;38(7):839–44.
- [8] Silbernagel KG, Nilsson-Helander K, Thomeé R, Eriksson BI, Karlsson J. A new measurement of heel-rise endurance with the ability to detect functional deficits in patients with Achilles tendon rupture. *Knee Surg Sports Traumatol Arthrosc* 2010;18:258–64.
- [9] Arner O, Lindholm A. Subcutaneous rupture of the Achilles tendon; a study of 92 cases. *Acta Chir Scand Suppl* 1959;116:1–51.
- [10] Bhandari M, Guyatt GH, Siddiqui F, Morrow F, Busse J, Leighton R, et al. Treatment of acute Achilles tendon ruptures: a systematic overview and meta-analysis. *Clin Orthop Relat Res* 2002;400(july):190–200.
- [11] Lo IK, Kirkley A, Nonweiler B, Kumbhare DA. Operative versus nonoperative treatment of acute Achilles tendon ruptures: a quantitative review. *Clin J Sport Med* 1997;7:207–11.
- [12] Leppilahti J, Orava S. Total achilles tendon rupture. A review. *Sports Med* 1998;25:79–100.
- [13] Möller M, Movin T, Granhed H, Lind K, Faxén E, Karlsson J. Acute rupture of tendon Achillis: a prospective randomised study of comparison between surgical and non-surgical treatment. *J Bone Joint Surg Br* 2001;83:843–8.
- [14] 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.
- [15] Fortis AP, Dimas A, Lamprakis AA. Repair of achilles tendon rupture under endoscopic control. *Arthroscopy* 2008;24:683–8.
- [16] Krackow KA, Thomas SC, Jones LC. A new stitch for ligament-tendon fixation. Brief note. *J Bone Joint Surg Am* 1986;68:764–6.
- [17] Carter TR, Fowler PJ, Blokker C. Functional postoperative treatment of Achilles tendon repair. *Am J Sports Med* 1992;20:459–62.
- [18] Maffulli N, Tallon C, Wong J, Lim KP, Bleakney R. Early weightbearing and ankle mobilization after open repair of acute midsubstance tears of the achilles tendon. *Am J Sports Med* 2003;31:692–700.