THE JOURNAL OF BONE & JOINT SURGERY (Br)

Acute rupture of tendo Achillis

A PROSPECTIVE, RANDOMISED STUDY OF COMPARISON BETWEEN SURGICAL AND NON-SURGICAL TREATMENT

M. Möller, T. Movin, H. Granhed, K. Lind, E. Faxén, J. Karlsson

From Sahlgrenska University Hospital, Gothenburg and Huddinge University Hospital, Stockholm, Sweden

In a prospective, randomised, multicentre study, 112 patients (99 men and 13 women, aged between 21 and 63 years) with acute, complete rupture of tendo Achillis were allocated either to surgical treatment followed by early functional rehabilitation, using a brace, or to non-surgical treatment, with plaster splintage for eight weeks. The period of follow-up was for two years. Evaluation was undertaken by independent observers and comprised interviews, clinical measurements, isokinetic muscle performance tests, heel-raise tests and an overall outcome score.

The rate of rerupture was 20.8% after non-surgical and 1.7% after surgical treatment ($p < 0.001$). Surgical and non-surgical treatment produced equally good functional results if complications were avoided. However, the rate of rerupture after non-surgical treatment was unacceptably high.

J Bone Joint Surg [Br] 2001;83-B:843-8.
Received 30 August 2000; Accepted after revision 23 February 2001

There are only two randomised, prospective studies in the English literature which compare the surgical and non-surgical treatment of rupture of tendo Achillis.[1,2] In that of Nistor,[1] non-surgical treatment produced as good a functional outcome as operation, with less risk of complications such as wound breakdown and infection. By contrast, Cetti et al[2] concluded that surgical treatment resulted in a better outcome and patient satisfaction, with the same incidence of complications as conservative management. In other reports operation followed by early functional rehabilitation has produced favourable results compared with prolonged postoperative immobilisation.[3-8]

Controversy continues with regard to the optimal treatment for this injury and, in a recent review, Maffulli[9] described a need for a comparative study with a modern design. Our aim therefore was to compare, prospectively, conservative with operative treatment in a large series randomly selected for each method.

Patients and Methods

Between January 1995 and July 1997, 112 patients were included in a prospective, randomised, multicentre study; 59 had surgical treatment and 53 were treated conservatively. The patients were aged from 16 to 65 years at the time of injury and had a closed rupture, with not more than seven days before presentation. They were excluded if they had had a previous injury to the same tendon, if there was functional impairment on the contralateral side, or if they suffered from diabetes mellitus, neurovascular disease or were immunosuppressed.

Table I gives the clinical details for the two groups. There was a total of 99 men and 13 women with a mean age at injury of 39.1 years (SD 8.2). In the surgical group there were 51 men and eight women with a mean age of 39.6 years (21 to 63) and in the conservative group 48 men and five women with a mean age of 38.5 years (26 to 59). The characteristics of the patients were similar in both groups ($p > 0.05$); 100 patients (89%) sustained the injury during sports activities.

Of the 112 patients who were originally included in the study, three, who had been randomly allocated to conservative treatment, did not accept this recommendation. They were followed prospectively and were analysed in two ways. The main variables, such as the outcome score at 12 months and complications, were analysed as part of both the treatment group and the 'intention to treat' group. For all other variables, they were analysed in the surgical group. One patient who suffered a stroke one year after the injury is the only one who was not evaluated clinically or by questionnaire at two years. Rerupture was regarded as failure of treatment. These patients were excluded from the study because they all subsequently underwent surgical treatment.

M. Möller, MD
H. Granhed, MD, PhD
K. Lind, RPT
E. Faxén, RPT
J. Karlsson, MD, PhD
Department of Orthopaedics, Sahlgrenska University Hospital Östra and Sahlgrenska, SE-416 85 Göteborg, Sweden.

T. Movin, MD, PhD
Department of Orthopaedics, Huddinge University Hospital, SE-141 86 Stockholm, Sweden.

Correspondence should be sent to Dr M. Möller.

0301-620X/01/611676 $2.00

Table I. Details of both groups of patients with rupture of tendo Achillis. Data are not available for all patients

	Surgical		Non-surgical	
	Number	**%**	**Number**	**%**
Number of patients	59	*53*	53	*47*
Gender				
Male	51	*86*	48	*91*
Female	8	*14*	5	*9*
Injured side				
Left	34	*57*	30	*57*
Right	25	*43*	23	*43*
Dominant hand				
Left	2		2	
Right	50	*94*	43	*96*
Ambidextrous	1		0	
Dominant*leg = injured leg	18	*47*	18	*53*
Occupation				
Sedentary	13	*22*	22	*41*
Light and mobile work	32	*54*	22	*41*
Heavy work	14	*24*	9	*18*
Participation				
In recreational sports	42	*71*	35	*66*
In competitive sports	5	*8*	3	*6*
No participation in sports regularly	12	*21*	15	*28*

* the dominant leg is the leg preferred for kicking a ball

The diagnosis was based on a palpable gap in the tendon and a positive calf squeeze test.[10,11] The patients who opted not to be included in the study were offered the standard treatment, which was non-surgical at that time. The randomisation was blinded, using identical envelopes. The patients were randomly allocated to either treatment in plaster in equinus or surgical repair followed by early functional rehabilitation. They received written and verbal information about the study and its purpose according to the Helsinki Declaration. The study was approved by the human research Ethics Committees at the Faculty of Medicine, Gothenburg University and the Karolinska Institute, Stockholm.

Conservative management was a below-knee plaster cast with the ankle in equinus for four weeks. The cast was then changed with the ankle in a neutral position. This was worn for a further four weeks and weight-bearing allowed.

Surgical treatment was carried out under local, spinal or general anaesthesia, with a short (6 to 8 cm) skin incision placed medially over the rupture. The repair consisted of an end-to-end suture without augmentation, using a modified Kessler technique. The paratenon was carefully closed. The foot was placed in a below-knee plaster in the position achieved after surgery, about 30° of equinus. Prophylactic antibiotics and prophylaxis against deep-vein thrombosis (DVT) were given. The plaster was replaced by a brace (ROM-Walker, Don Joy; Smith & Nephew, Buena Vista, California; Fig. 1) approximately 12 days after surgery. Full weight-bearing and range-of-movement exercises were encouraged during weeks three to eight. The brace initially prevented dorsiflexion beyond 30° of equinus. Movement to 10° of equinus was allowed at four weeks and after six weeks dorsiflexion of 10° was permitted.

A bilateral heel-raise of 15 mm for four to eight weeks and identical rehabilitation protocols were used in both groups. Almost all of the patients (97%) had physiotherapy. Full weight-bearing without crutches was allowed at eight weeks. Functional closed-chain exercises were then started and were followed by stationary cycling and swimming at nine weeks. Eccentric training was added to the concentric exercises at three months. At four months, running and sports-specific training were allowed. The goal was to resume sports activities six months after injury.

Fig. 1

The Don-Joy ROM-walker orthosis used in the treatment of the surgical group.

Table II. Outcome one year after rupture of tendo Achillis using five objective and three subjective outcome scores

Category	Score	Surgical		Non-surgical	
		Number	%	Number	%
Dorsiflexion and plantar flexion at the ankle joint on the injured side compared with the non-injured side. Difference in either direction (degrees).					
≤ 5	10	27	*52*	14	*42*
10	5	11	*21*	10	*30*
≥ 15	0	14	*27*	9	*27*
Calf muscle atrophy measured as maximum calf circumference as a ratio between injured and non-injured side (%)					
97 to 100	10	30	*58*	15	*45*
93 to 96	5	19	*37*	15	*45*
< 93	0	3	*5*	3	*10*
Isokinetic plantar flexion peak torque at 30°/second supine, extended knee, expressed as a ratio between injured and non-injured side					
95 to 100	15	14	*27*	9	*27*
85 to 94	10	12	*23*	4	*12*
75 to 84	5	10	*19*	4	*12*
< 75	0	16	*31*	16	*49*
Endurance measured as number of heel-raises, ratio between injured and non-injured side					
80 to > 100	15	11	*22*	6	*19*
55 to 79	10	19	*37*	12	*36*
1 to 54	5	14	*27*	12	*36*
Impossible	0	7	*14*	3	*9*
Pain					
None	10	48	*92*	29	*88*
Moderate	5	3	*6*	1	*3*
During walking	0	1	*2*	3	*9*
Complications*					
None	15	40	*77*	32	*97*
One minor complication	10	11	*21*	1	*3*
More than one minor complication	5	1	*2*	0	
Major complication	0	0		0	
Subjective assessment of result of treatment on visual analogue scale					
90 to 100	10	19	*37*	6	*19*
75 to 89	5	25	*48*	12	*37*
< 75	0	8	*15*	14	*44*
FIL (see text)					
0 to 5	15	28	*55*	17	*52*
6 to 10	10	12	*23*	8	*24*
16 to 30	5	5	*10*	5	*15*
> 30	0	6	*12*	3	*9*

* patients with rerupture were excluded at the one-year follow-up

Follow-up examinations were carried out at 8 and 12 weeks and at 6, 12 and 24 months. At 8 and 12 weeks, evaluations were undertaken separately by an orthopaedic surgeon and a physiotherapist. Three independent physiotherapists carried out the 6-, 12- and 24-month examinations.

Measurements of maximum calf circumference were made with the patient in the prone position. The range of active ankle movement was measured in the supine position using a goniometer. The times of return to work and of resumption of sports were noted. A visual analogue scale (VAS) was used to evaluate the patients' opinion of their treatment.

Functional performance was measured using a recently developed functional index for the lower leg and ankle (FIL) (Andersson and Styf, unpublished data).[12] The overall result was divided by the mean of the VAS answers. At least nine of the 11 parameters had to be answered for the analysis to be used. The best possible result was zero, indicating no problems, when undertaking each activity.[12]

The outcome was measured using a scoring scale including five objective and three subjective parameters

Table III. Patients' subjective results of treatment

	Surgical		Non-surgical		
Category	**Number**	**Value (SD)**	**Number**	**Value (SD)**	**p value**
VAS for quality of life during the eight-week treatment period	46	91.0 (9.2)	47	73.1 (22.7)	<0.0001
VAS for the result of the treatment given at:					
Eight weeks	49	89.2 (10.3)	40	74.9 (19.1)	<0.0001
Six months	45	83.5 (16.4)	35	72.3 (19.4)	0.0063
One year	49	84.2 (13.8)	32	75.9 (17.1)	0.018
Two years	52	88.7 (9.0)	38	70.3 (20.1)	0.0001
FIL at:					
Six months	40	20.9 (21.9)	29	22.5 (20.7)	0.76
One year	50	11.4 (15.1)	32	10.2 (13.8)	0.72
Two years	52	7.7 (13.1)	35	12.1 (15.8)	0.16
Rupture score (%) at one year	52	*70.2 (15.9)*	33	*65.2 (15.2)*	0.15

Table IV. The patients' opinion of treatment at eight weeks and six months

	Surgical		Non-surgical	
	At eight weeks	**At six months**	**At eight weeks**	**At six months**
Number of patients who rated treatment				
Excellent	37	35	26	20
Good	6	9	9	13
Fair	0	2	3	3
Poor	0	0	0	0

Table V. Clinical data regarding time before return to work for patients

	Surgical		Non-surgical	
	Number	**Days (SD)**	**Number**	**Days (SD)**
Sick leave	59	54.9 (47.9)	52	73.4 (56.5)
Time before return to work				
Heavy work	14	102.2 (52.7)	9	108.1 (34.7)
Light, mobile work	32	35.7 (38.0)	22	67.2 (65.9)
Sedentary	13	30.8 (36.5)	21	33.2 (54.7)

(Table II). This scale is a modification of the scores previously described by Thermann, Zwipp and Tscherne,[13] McComis, Nawoczenski and DeHaven[14] and Leppilahti et al.[15] A total score of 100 represents the best result that could be achieved. The score was calculated as a percentage of the possible score excluding missing parameters. Complications, recorded according to Lo et al,[16] were noted as they occurred.

Isokinetic ankle strength was measured at 30° per second with a KINetic-COMmunicator dynamometer (KIN-COM 500 H; Chattex Corporation, Chattanooga, Tennessee). The patient lay supine with the knee extended. Three consecutive tests were carried out and the highest recorded concentric peak torque was used for the analysis. The ratio of the injured side compared with the non-injured side was analysed.

A modified standing heel-raise test was used to evaluate the endurance of the calf muscles.[17] The addition of a block kept the ankle in a position level with a light beam. The number of standing unilateral heel-raises at a frequency of 40 per minute and above a level 5 cm from the floor was counted. The test was stopped when the subject was unable to continue proper heel-raises. Each test was repeated twice and the mean was used for analysis.

Statistical analysis. The distribution of the variables is given as the mean and standard deviation (SD). We used Fisher's exact test, the chi-squared and an unpaired two-tailed Student's *t*-test to analyse differences in baseline data between the treatment groups. Fisher's exact test was used to analyse the incidence of rerupture. The VAS scales, the FIL test, clinical evaluation of the rupture and time before return to work were analysed using an unpaired two-tailed Student's *t*-test for differences between the treatment groups. The patients' opinions of treatment and return to sports were analysed using the Mantel-Haentzel test. A p value of < 0.05 was considered to be significant.

Results

Rerupture after non-surgical treatment occurred in 11 patients (20.8%) compared with one patient (1.7%) after operation ($p = 0.0013$). The diagnosis of complete rerupture

was confirmed in all 12 patients during subsequent surgery. All occurred between 8 and 18 weeks after the injury. The single rerupture in the surgical treatment group was a result of a fall. One of the reruptures in the non-surgical group occurred during dancing and the remaining ten while walking. There was one case of superficial infection, eight of skin adhesions and one of disturbance in sensitivity in the surgical group, but none resulted in permanent functional impairment. One patient in the non-surgical group had a DVT and one excessive lengthening of the tendon.

The patients' opinions of the treatment were categorised and evaluated (Table III). Eight weeks after injury, all the surgically-treated patients claimed that they would have chosen the same treatment on a possible second occasion. Analysis of the functional index revealed no significant differences between the treatment groups (Table III). The differences between the two groups were significant when analysing the patients' opinions of the treatments and quality of life during the treatment (Tables III and IV). The score was 70.2% in the surgical and 65.2% in the non-surgical group at one year (Tables II and III). The three patients who requested an operation were included in the non-surgical treatment group in the 'intention to treat' analysis. This did not alter the results.

Nine of ten patients in both groups attended hospital within 12 hours and in none was the delay more than three days. The plaster treatments were all administered on an outpatient basis. Casts were applied immediately after presentation, 95% of the operations were carried out within two days and the mean hospital stay for the surgical group was 1.1 days.

As shown in Table V, the time before return to work in the surgical group was 54.9 days (0 to 197) compared with 73.4 days (0 to 250) in the conservative group ($p = 0.06$). Patients with a light job requiring mobility had a significantly shorter period of sick leave if they were in the surgically-treated group ($p = 0.03$). In both groups, 54% of the patients had resumed sports at the same level as before the injury and approximately 30% had the functional ability to resume sport, but did not wish to. In the surgically-treated and the non-surgically-treated group, 16% and 14%, respectively, of the patients had not resumed sports at one year, as a result of the injury.

The range of active plantar flexion was reduced by 5.2° (SD 5.5) in the surgically-treated group and by 4.1° (SD 4.6) in the non-surgically-treated group, one year after the injury. An increase in the range of dorsiflexion on the injured side was observed in 42% and 48%, respectively, of the patients in the surgical and non-surgical groups but the difference was not significant. Isokinetic strength ratios varied between 0.82 and 0.90. There were no significant differences between the treatment groups and no change, over time, in either group. Endurance testing using heel-raise counts did not reveal any significant differences between the groups. Two years after the injury, 69% of the endurance observed on the uninjured side, had been regained in the surgically-treated group, compared with 54% in the non-surgically-treated group. In the non-surgical and surgical groups, 22% and 8%, respectively, were not able to carry out a single heel raise on the injured side two years after the injury.

Discussion

In our prospective study, after the exclusion of reruptures, no significant differences were found between the treatment groups. Non-surgical treatment is usually reported to be associated with a higher rate of rerupture than operation.[16,18] If a rerupture is avoided, conservative treatment appears to produce functional results which are as good as those after operation.[1] Advocates of non-surgical treatment quote the advantages of avoiding surgical complications, but we encountered no problems with wound healing.

Concerns have been expressed over the delay in initiating conservative treatment which should be started if possible within 72 hours. All our patients were treated within that time limit and 90% within 12 hours of injury.

Mortensen et al[4] in a randomised study showed that early restricted movement after surgical repair is preferable to postoperative immobilisation, which accords with several non-randomised studies.[3,5-7,19] The rehabilitation protocol was identical in both of our groups and was started at the same time. We followed surgical treatment by early, functional rehabilitation, using a brace, and therefore cannot tell if the results in the surgical group depend mainly on the repair itself, the early functional rehabilitation or the combination of both.

In Nistor's prospective, comparative study,[1] non-surgical treatment was favoured as there was less risk of complications. Rerupture occurred in 8% of the patients in the non-surgical group and in 4% in the surgical group which was not statistically significant. In the other prospective, randomised study, surgical treatment with simple, end-to-end suturing followed by immobilisation in a cast, produced favourable results compared with treatment by a cast only;[2] there were 13% of reruptures in the conservative group and 5% in the surgical group which was not significant. In our study, the rate of rerupture in the surgically-treated group was 1.7%, but 20.8% in patients treated conservatively. In previous reviews of the literature,[1,16,18,20] the rates of rerupture have been between 1% and 3% after surgical treatment and 12% and 18% after non-surgical treatment. In some small series, rates of rerupture of 35% and 40% have been reported after conservative treatment.[21,22] Minor complications, which did not affect the final outcome, were more common in our surgical group, as in previous studies.

In contrast to the findings of Cetti et al,[2] our experience shows that surgical treatment can be carried out with a short hospital stay.[1] We also found that patient satisfaction after operation was significantly higher than after conservative management which conflicts with the findings of

Nistor.[1] We also showed that repair of a rupture, using the open technique with a limited incision, produced few complications. The technique is simple in contrast to most percutaneous techniques and complex open procedures.

The type of occupation in the patient population has seldom been defined in previous studies. For obvious reasons, patients with a heavy manual job cannot return to work early whereas those with a sedentary job may do so. In our study, we noted that patients with jobs requiring mobility returned to work sooner after surgical treatment.

Only 54% of our patients returned to their preinjury level of sports activity. These values are somewhat lower than in other studies.[1,3,15] They are based on the patient's own opinion and probably reflect the true numbers in a population of predominantly recreational athletes. Many of the patients who did not resume sports activities claimed that they feared another rupture.

Active ankle movement at one year showed an increased dorsiflexion in both groups.[14] We found only one patient in the non-surgical group with significant lengthening of the tendon. Patients in the surgical group recovered 87% of their strength at one year compared with 90% in the non-surgical group confirming previous findings.[1,2,23,24]

Neither Nistor[1] nor Cetti et al[2] studied endurance. Our results with the modified heel-raise test are similar to those of Häggmark et al,[17] but the difference between our treatment groups at the two-year follow-up was smaller. The relatively low ratios can be explained by the rigorous way in which the tests were undertaken. To our knowledge, there is no accepted scoring system for assessing the outcome after rupture of tendo Achillis. The system which we have used adds subjective evaluation to the features previously described.[13-15]

We conclude that surgical treatment followed by early functional rehabilitation is a safe and reliable method of treatment for rupture of tendo Achillis. With careful surgery, the risk of significant complications can be minimised, and both surgical and non-surgical methods produced equally good long-term results in those patients in whom rerupture did not occur. Conservative management resulted in failure in every fifth patient, and cannot be regarded as acceptable in healthy, active patients under the age of 65 years.

The authors wish to thank Marie Bergqvist, Kerstin Lindgren and Pernilla Svensson at the Department of Physiotherapy, Huddinge University Hospital and secretaries Britt-Marie Johansson (Huddinge), and Gun-Britt Åsell Otreus (Göteborg) for their valuable help with the follow-up arrangements; also for help with the statistical evaluation, gratitude is due to Henrik Ahlbom and Nils-Gunnar Persson (Göteborg).

This study was supported by the Swedish Centre for Research in Sports.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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