

# Nonoperative Treatment of Acute Rupture of the Achilles Tendon

## Results of a New Protocol and Comparison with Operative Treatment

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**Background:** Excellent results are reported from both nonoperative and operative treatment of Achilles tendon rupture.

**Purpose:** To describe a new nonoperative treatment protocol for Achilles tendon ruptures and compare outcomes with operative treatment.

**Study Design:** Retrospective cohort study.

**Methods:** We treated 23 patients nonoperatively with an equinus ankle cast and boot and compared their outcome with that of a group of 24 patients previously treated operatively. Muscle strengthening and walking with full weightbearing were started as soon as tolerated in both groups. Follow-up examinations were performed for 18 nonoperatively treated patients after 23 months and for 15 operatively treated patients after 49 months.

**Results:** Subsidence of pain, return to unaided walking, and return to work was faster in the nonoperatively treated group. Patient satisfaction, return to sports, and ultimate strength was the same for both groups. The complication rate was similar, except for reruptures: four early in the nonoperative group and one late in the operative group. Two types of reruptures occurred in the nonoperative group: 1) normally healing tendon subjected to new trauma, rerupturing in the healing zone, and achieving a good result with continued nonoperative treatment; and 2) tendon failing proximal to the initial rupture at the muscle-tendon junction, without trauma, requiring operative repair and augmentation.

**Conclusions:** Results of operative and nonoperative treatment were equivalent.

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The best method of treatment for acute closed ruptures of the Achilles tendon continues to be debated. Modern concepts of nonoperative treatment have been shown to produce good results with acceptable complication rates.<sup>11,12,14,19,20,27,28</sup> Advocates of operative treatment claim to obtain a stronger repair with a faster rehabilitation and better ultimate strength, with fewer reruptures.<sup>4-6,9</sup> Percutaneous repair techniques have been used in an attempt to reduce operative morbidity.<sup>13,15,17</sup> The benefits of early functional activity in the healing of a tendon are well known.<sup>7,22,29</sup> Recent studies have shown that the return to function is fast and safe when functional

aftercare is incorporated into an operative<sup>3,16</sup> or a nonoperative<sup>14,24,27,28</sup> treatment plan. The purpose of this study was to present the results of our nonoperative treatment program and compare its results with those of a surgical treatment program in a similar group of patients previously treated at our institution.

### PATIENTS AND METHODS

In a retrospective study, we compared two consecutive groups of patients who were treated at our institution from 1993 to 1998 for acute rupture of the Achilles tendon. Exclusion criteria for this study were delayed presentation (more than 48 hours after rupture), open rupture, systemic disease requiring immunosuppressive treatment, and fluoroquinolone-associated rupture. Patient age of more than 65 years was also a criterion for exclusion because inferior results have been reported for any treat-

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ment in patients more than 65 years of age, according to Nestorson et al.<sup>18</sup> From 1993 to 1996, all patients ( $N = 24$ ) were operated on with use of a simple tendon suture and rehabilitated in a "walker" in neutral ankle position and with full weightbearing as soon as tolerated. A report on some of these patients (with different inclusion criteria, especially no age restriction) has already been presented.<sup>25</sup> Because of the positive results reported by Thermann et al.,<sup>27,28</sup> we treated all patients ( $N = 23$ ) from 1996 to 1998 according to their nonoperative protocol, with some modifications, with use of an equinus ankle cast. The patients were rehabilitated in a boot with a heel lift and were permitted full weightbearing as soon as tolerated. Once the number of patients in this group was equal to that of patients treated surgically (meeting the same inclusion criteria) and once a minimum follow-up of 12 months was reached, the patients were reexamined and their results were compared with those of the surgically treated group.

The diagnosis was established by the physical findings of a palpable complete defect of the substance of the Achilles tendon, enlargement of the gap on passive dorsiflexion of the foot, loss of the spontaneous plantar flexion position of the foot (patient prone, knee extended, foot hanging unsupported over the edge of the examination table), loss of plantar flexion power, and a positive Thompson sign. A complete defect in the tendon substance could clearly be palpated in all but one patient who had a hematoma; this patient met all the other criteria, so the diagnosis was clear. All patients were seen within 24 hours of the injury; 29 of the 47 ruptures occurred during sports activities.

#### Nonoperative Treatment

One additional parameter was evaluated for patients to qualify for nonoperative treatment. With the patient prone on the examination table, the ankle was passively brought into 20° of plantar flexion. Approximation of the tendon stumps in this position had to be complete or near complete (less than 5 mm) on digital palpation and was

verified ultrasonographically. The patients then received an ankle dressing with semirigid casting tape (SoftCast, 3M Health Care, St. Paul, Minnesota) in 20° of ankle plantar flexion. The cast material was allowed to bind with the patient standing on a 20° wedge, fully weightbearing (Fig. 1A). The patients were fitted with a commercially available ankle boot (Ortho Rehab Total; Künzli, Brugg, Switzerland), which has a built-in 1-cm heel lift and a rockerbottom sole. Inside the boot, two heel wedges of 2 cm each were placed (patients of small stature had a total of only 3.5 cm) (Fig. 1B). Walking was allowed with weightbearing as tolerated. Thromboprophylaxis was administered for 10 to 14 days. The cast was removed for the first time after 7 days, when most of the swelling had subsided. Healing of the tendon was checked by assessing reestablishment of tendon continuity by means of palpation, the Thompson test, and isometric triceps muscle activation. The ankle was again placed in a cast in 20° of plantar flexion. The cast was then changed at 10- to 14-day intervals, mainly for hygienic reasons. The patients wore the boot all day and were allowed to take it off at night but were instructed not to walk around without it because the cast alone would not provide sufficient protection (Fig. 1C). At 6 weeks, the cast was removed, and the heel lift in the boot was reduced to 2 cm for another 2 weeks (Table 1). At 8 weeks the heel lift was removed. The patients continued to wear the boot for an additional 4 weeks. After that, the patients were allowed to wear normal shoes, with a 5- to 8-mm heel wedge at their discretion.

All of the patients in the nonoperative group were instructed by physical therapists immediately after they had received their initial treatment. They started the rehabilitation program on the 2nd or 3rd day after the injury, as soon as they felt comfortable in the boot. They performed exercises of level walking, single-legged stance, isometric strengthening, and stationary bicycling (Table 1). After 6 weeks, range of motion exercises for the ankle were added. At 8 weeks, calf muscle strengthening was



**Figure 1.** A, after application of the semirigid casting tape, the patient stands on the heel wedge (designed to keep the ankle in 20° of plantar flexion), bearing weight as tolerated, while the cast is allowed to bind; B, commercially available ankle boot and heel wedges (2 cm each); C, patient standing in the boot, with ankle cast applied.

TABLE 1  
Course of Nonoperative Treatment for Achilles Tendon Rupture

Week	Heel lift (cm)	Cast	Boot	Rehabilitation
0	4	+	+	Walking, isometrics, stationary bike
6	2	-	+	ROM <sup>a</sup> ankle exercises
8	0	-	+	Eccentric calf
12	0	-	-	Running, jumping

<sup>a</sup> Range of motion.

intensified. At 12 weeks, the patients stopped wearing the boot, and running and jumping on level ground was initiated, together with single-legged heel raises. At 16 weeks, running exercises were begun as well as exercises specific to the type of sports the patients had performed before their injury. Restrictions remained for sports activities with a high potential for uncontrolled ankle motion (such as soccer, volleyball, basketball), until 6 months after the injury.

Operative Treatment

Many different surgeons performed the operations, with use of a medial longitudinal approach. The tendon was repaired with a single Kessler-type stitch with absorbable (polydioxanone) monofilament suture material (no. 0). Postoperatively, the patients' injured ankles were immobilized in a below-knee nonweightbearing cast in gravity equinus. Thromboprophylaxis with low-molecular weight heparin was continued until 6 weeks postoperatively. As soon as the pain had subsided and wound healing permitted, active range of motion exercises and weightbearing as tolerated in a removable ankle-foot orthosis (walker) in neutral ankle position were encouraged. The patients were allowed to find their own pace in reducing ankle equinus to neutral and in increasing weightbearing to full body weight. They were taught to perform isometric strengthening exercises. At 6 weeks postoperatively, use of the walker was discontinued, and the patients received instructions for their intensified rehabilitation.

Follow-up Examinations

At every examination, the resting length of the muscle-tendon unit was assessed as a means for evaluation of tendon lengthening. With the patient prone and the feet hanging over the edge of the examination table, spontaneous ankle plantar flexion was measured on both sides with a goniometer. The goniometer was placed with one limb on the examination table and the other limb along the lateral hindfoot border. The difference between the two measurements was recorded. Previous measurements made on lateral ankle radiographs had shown that a 10° difference in ankle dorsiflexion/plantar flexion was approximately equivalent to a 10-mm difference in Achilles tendon length. A sonographic control examination was not thought to provide additional and relevant information.

A modified Thermann score<sup>28</sup> was used to summarize objective and subjective parameters (Table 2). Isokinetic Cybex dynamometer (Cybex Int., Medway, Massachu-

TABLE 2  
Evaluation Score Modified from Thermann et al.<sup>28</sup>

Parameter	Points <sup>a</sup>
Reduction of ankle dorsiflexion	
None	10
-5°	5
-10°	2
More than 10°	0
Difference in spontaneous plantar flexion (prone)	
None	10
-5°	5
-10°	2
More than 10°	0
Difference in calf circumference	
None	10
-1 cm	5
-2 cm	3
More than 2 cm	0
Static single-legged heel raise	
1 minute	10
10 seconds	5
Barely possible	1
Impossible	0
Thompson test	
Negative	5
Positive	0
Peak torque (Cybex) <sup>b</sup>	
More than 95% of healthy side	10
85%	8
75%	6
65%	2
Less than 65%	0
Pain	
None	10
Only on maximal exertion	8
On normal exertion	3
On minimal exertion	2
At rest	0
Subjective loss of power	
None	10
Minor loss on maximal exertion	8
Minor loss on normal exertion	6
Moderate loss on normal exertion	2
Severe loss	0
Ability to perform sports	
At previous level	10
Minimal restriction	8
Moderate restriction	3
Impossible	0
Hypersensitivity to meteorological changes	
None	5
Present	0
Subjective overall assessment by patient	
Very good	10
Good	8
Moderate	6
Fair	2
Poor	0

<sup>a</sup> Total, 100 points: very good, 90+; good, 80+; moderate, 70+; fair, 60+; poor, less than 60 points.

<sup>b</sup> Cybex Int., Medway, Massachusetts.

sets) testing was performed at the last examination, with the patient prone, knee extended, at 30, 120, and 180 deg/sec (three repetitions, average values). For endurance testing, the side-to-side difference of the maximum number of single-legged heel raises (>5 cm above ground, with the knee fully extended, and with a cadence of 30 per minute) on each side and the ability to stand on the

injured foot with a single-legged heel raise (5 cm above ground) for 1 minute were recorded.

All patients were reexamined at 3, 6, and 12 months and at the last visit. Because of the design of this study (consecutive groups), an average difference in follow-up of 26 months between the two groups resulted. This shortcoming was partly compensated for by contacting all the nonoperatively treated patients again by telephone to inquire whether any changes in their functional status or any recent complications had occurred. Thus, a comparable length of follow-up (49 months in each group) regarding complications, pain, function, and satisfaction could be obtained.

Of the initial 23 patients in the nonoperative group, 2 patients returned to their homes in a foreign country at 3 and 7 months after an uneventful course and could not be reached for further information. Two patients refused to return for follow-up examinations, although their healing progress was normal (at 5 and 7 months, respectively). One patient was unable to cooperate with the testing because of mental illness. Objectively, he had a normal course of tendon healing. The remaining 18 patients returned for a follow-up examination at an average of 23 months (range, 12 to 42) after injury. Approximately 2 years later, all of these patients were contacted again by telephone to inquire about any complications or changes in their functional status, resulting in an average final observation time of 49 months. The data from the two patients with reruptures treated operatively were included up to the time of rerupture.

Of the 24 patients in the operative group, 5 patients could not be found. Two patients (with a follow-up of more than 12 months) were questioned by telephone but refused to come in person for the examination; they had had an uneventful postoperative course and tendon healing. One patient, who was excluded from the final evaluation, had had a deep infection, with good healing after a debridement. One patient had died of a postoperative pulmonary embolism. Thus, 15 patients could be examined in person at an average of 49 months (range, 30 to 79) after the operation.

Statistical Evaluation

The Mann-Whitney *U*-test was used to compare the different parameters of the two groups.

RESULTS

One patient was excluded from nonoperative treatment because of persistent tendon diastasis of more than 5 mm in 20° of ankle plantar flexion. Intraoperatively, the persisting gap was explained by the fact that the distal tendon stump had dislocated anteriorly through a rent in the paratenon sheath.

Subjective and objective results at 6 months and final follow-up are listed in Tables 3 and 4. There was a significantly shorter period of pain at rest (*P* < 0.01), a shorter period of walking with crutches (*P* < 0.0001), and less absence from work for the office workers (*P* < 0.01) in the

TABLE 3  
Comparison of Nonoperative and Operative Group during the First 6 Months after Injury

Variable	Nonoperative group	Operative group
Number of patients	23	15
Average age in years (range)	39 (17 to 55)	38 (28 to 51)
Sex (M/F)	15/8	13/4
Patients with previous Achilles pain	3	2
Patients with previous contralateral rupture	1	3
Hospitalization time (days)	0	5.1 (3 to 7)
Period of pain at rest (days after injury)	1.8 (0 to 14)	4.9 (0 to 14)
Period of pain on walking (weeks after injury)	3.1 (0.5 to 14)	4.9 (1 to 12)
Begin walking without crutches (weeks)	2.2 (0.5 to 7)	6.8 (3 to 11)
Absence from work (weeks)		
All patients	3.9 (0 to 12)	5.7 (1 to 12)
Office work	0.8 (0 to 14)	5.5 (1 to 10)
Medium work	3.9 (0.5 to 10)	6.4 (2.5 to 12)
Heavy work	14 (8 to 20)	no patient
Resumption of sports (weeks)	24	25

TABLE 4  
Comparison of Nonoperative and Operative Groups at Last Follow-up

Variable	Nonoperative group	Operative group
Number of patients	16	15
Patients with increased dorsiflexion		
5°	3	4
10°	0	0
Difference of calf circumference (cm)	-0.9 (-2.5 to 0)	-1.1 (-2 to 0)
Repetitive single-legged heel raise (% of healthy side)	85	83
Static single-legged heel raise for 1 minute (% of patients)	94	87
Peak plantar flexion torque (Cybex; % of healthy side)	101	99
Total work (Cybex; % of healthy side)	103	90
Pain on maximum exertion (no. of patients)	5	3
Subjective assessment (% of patients with good to excellent results)	100	93
Modified Thermann score (maximum, 100 points)	85 (65 to 100)	84 (68 to 98)

nonoperative group. All of the other parameters showed no statistically significant differences between the groups.

One patient in the operative group continued to have pain despite the absence of objective findings. One patient in the nonoperative group was unable to work for 20 weeks because of unrelated knee pain.

Complications

The complications are listed in Table 5. The rerupture in the operative group occurred 3 years after the initial rup-

TABLE 5  
Complications Occurring in Each Group during Follow-up

Complication	Nonoperative group	Operative group
Rerupture with trauma	2	1
Rerupture without trauma	2	0
Deep infection		1
Deep vein thrombosis	2	2
Fatal pulmonary embolism		1
Persistent scar pain		1

ture, was treated nonoperatively at another hospital, and healed well. Of the four reruptures in the nonoperative group, two (in patients 30 and 37 years of age) occurred as a result of a new trauma in the early period of unprotected walking. The first patient fell down stairs 7 weeks after the initial trauma, and during the fall her foot caught on a step and was violently pushed into dorsiflexion. Nonoperative treatment led to a good result. The second patient sustained a heavy blow to the Achilles tendon from a falling metal bar 10 weeks after the initial trauma. Nonoperative treatment again resulted in a good outcome. Two patients (40 and 44 years of age) sustained a rerupture at 8 and 12 weeks, respectively, without trauma, while walking normally. Neither of them had had pain before the initial rupture or the second rupture. Both were operated on with use of a Kessler-type tendon suture and augmentation of the repair with transfer of the flexor hallucis longus tendon. Intraoperatively, the rupture was found to be located proximal to the initial rupture, which was found to be healing solidly. The new rupture occurred close to the musculotendinous junction and was of almost "cut-like" ends and not of the usual "mop-tear" appearance. Deep vein thromboses occurred in two patients in each group, within 4 weeks of the rupture, and healed without sequelae except for the patient with the fatal pulmonary embolism.

## DISCUSSION

The optimum treatment for young and middle-aged patients with an acute closed rupture of the Achilles tendon continues to be debated.<sup>2-6, 8, 9, 11-21, 23-25, 27, 28, 30, 31</sup> Young and athletically active patients are thought to benefit especially from operative treatment because strength is said to be better and the rerupture rate lower.<sup>4, 9</sup> Most of the earlier nonoperatively treated patients had had their ankle immobilized in nonweightbearing casts or had received virtually no treatment at all.<sup>20</sup> Modern nonoperative treatment with almost immediate weightbearing began in 1972 when Lea and Smith<sup>12</sup> presented their excellent results with use of the gravity equinus walking boot cast. In 55 patients, they observed 7 reruptures, all of which they attributed to insufficient protection during the first 12 weeks of treatment. Saleh et al.<sup>24</sup> and McComis et al.<sup>14</sup> reported good results by using nonoperative treatment with free ankle motion and an orthosis blocking dorsiflexion. In 1989 and 1995, Thermann et al.<sup>27, 28</sup> presented their technique of using a walking boot with heel lift, worn day and night for 6 weeks, and immediate ag-

gressive rehabilitation. Excellent results with no reruptures and comparable strength between operated and nonoperated patients were obtained. Reilmann et al.<sup>23</sup> used the same protocol for 132 patients. They observed seven reruptures (5%) but overall good function. We used a protocol similar to that of Thermann et al., but we added the protective ankle cast for 6 weeks, allowing the patient to take off the boot at night and when not walking around. Use of the boot was continued until 12 weeks to add protection during the vulnerable phase from 6 to 12 weeks.

We are aware of the shortcomings of this study, which are its retrospective nature, the comparison of sequential groups, and the differences in the aftertreatment protocols. However, the key features of the aftertreatment were quite similar (full weightbearing as soon as tolerated, in a walker or boot, and immediate muscular rehabilitation). We therefore think that our conclusions are valid with minor reservations, although a larger-scale controlled trial would allow us to more precisely define the value of the tendon suture in the treatment of acute closed ruptures of the Achilles tendon.

Nonoperative treatment according to our protocol enabled the patients to resume their activities of daily living more rapidly than with the previously performed open operative treatment. Pain subsided more quickly and no hospital stay was necessary. Although the newer percutaneous repair techniques are usually performed on an outpatient basis and would certainly elicit less pain than the open technique, operative treatment would still be more painful than nonoperative treatment.

Application of the cast was very quick and easy. A few patients experienced skin problems on the dorsum of the foot, usually related to a crease in the cast from walking around without the boot. Skin problems sometimes occurred in hot weather with excessive sweating. In this case casts would be changed more frequently. No treatment was discontinued because of cast problems.

All of the nonoperatively treated patients showed solid early healing when the cast was first changed after 7 to 10 days. With the patient prone and the feet hanging over the edge of the table, the defect in the tendon was no longer palpable. The spontaneously plantar flexed position of the foot indicated an early restoration of continuity between the calf and the calcaneus, which was regularly confirmed by a positive active (isometric contraction) and passive (Thompson test) pull-through. We think that it is important to start nonoperative treatment within 24 to 48 hours of the rupture, before the tendon stumps are fixed in the dislocated position and before interposed granulation tissue prevents approximation. This is in accordance with the recommendations of Carden et al.,<sup>2</sup> who found equally good results from both types of treatment if started within 48 hours of the injury, but inferior results regarding strength in the nonoperative group when treatment was started later than 48 hours after the injury.

Two patients in the nonoperative group had reruptures when they sustained a new significant trauma. Nonoperative treatment was started over again and they had a good result without excessive lengthening of the tendon. These

two patients need to be distinguished from the two patients whose tendons reruptured spontaneously and whose lesions had an intraoperative appearance of a "fatigue" rupture. These two spontaneous reruptures were located in a frail zone at the musculotendinous junction, proximal to the thick and solidly healing distal part of the tendon (2 to 8 cm above the calcaneal insertion). Kannus and Jozsa<sup>10</sup> showed that degenerative changes in spontaneously ruptured tendons are the rule. It can be assumed that these changes are present along the entire tendon. Therefore, we think that it was the degeneration of the proximal portion of the tendon that caused the failure, while healing of the initial rupture more distally proceeded satisfactorily. A fatigue failure type of mechanism at the junction between the healing zone and the proximal tendon may explain the appearance of these second ruptures. Thermann et al.<sup>28</sup> had observed a rerupture in one of their patients who was more than 40 years of age. They assumed that the rerupture was due to the slowing of the healing process in older patients. Our two patients were 40 and 44 years of age, but the intraoperative findings contradicted the assumption of Thermann et al., as the initial ruptures were found to be solidly healing. The atrophic morphologic characteristics of these second ruptures in our two patients gave us the impression that a simple suture would not suffice. We therefore elected to reinforce the tendon suture with a flexor hallucis longus tendon transfer.

Our rerupture rate of 17% (4 of 23) was higher than the average rates reported in the literature (13% in the overview by Cetti et al.<sup>4</sup>) and is considerably higher than the absence of reruptures (0 of 28) in the series of Thermann et al.<sup>28</sup> Reilmann et al.<sup>23</sup> reported 5.3% reruptures (7 of 132) in their large series, in which Thermann's treatment protocol was used. We believe that our rerupture rate can be reduced to an acceptable and competitive value (lower than 5%) by better protecting the healing tendon during the vulnerable phase (6 to 12 weeks after the rupture). Brown et al.<sup>1</sup> and Thermann et al.<sup>26</sup> have shown in animal experiments that the tensile strength of nonsutured tendons is inferior to that of sutured tendons in the early phase of healing, whereas forces required to rupture were equal in the later phases. Retrospectively, our two patients with traumatic reruptures may have sustained the rerupture because the traumatic energy was more violent than what a boot can withstand. However, it would have been possible to identify the two other patients who had the spontaneous second ruptures. The thick early scar of the tendon distally and the short, thin tendon portion proximally should have been easily palpable on clinical examination. We have not seen this phenomenon in any other patients in our series. Now we would suggest early operative repair or prolonged protection (boot for 16 weeks, 4-cm heel lift until 8 weeks, 2-cm heel lift until 12 weeks) for such a patient. We still think that it is important to adhere to the principle of immediate controlled functional treatment as outlined by Thermann et al.,<sup>27,28</sup> as there is ample scientific evidence of the benefits of early functional loading to the healing of a tendon.<sup>7,22,29</sup>

Lengthening of the tendon was assessed by the differ-

ence in the spontaneous plantar flexion position of the ankle with the patient prone, knee extended, and the feet hanging over the edge of the examination table. We believe that this test is reliable, quick, and easy to perform. It is more sensitive in detecting a subtle tendon lengthening than testing for an increase in maximum ankle dorsiflexion. The latter test can be strongly influenced by the force applied by the examiner and by limitations due to an articular problem. Tendon lengthening occurred in both treatment groups to about the same amount (5° to 10°), but in neither group did it have a negative influence on the performance in the tests for strength and endurance. Lengthening is a well-known phenomenon and has been investigated in patients undergoing operative and nonoperative treatment. Brown et al.,<sup>1</sup> in their rabbit experiment, found a threefold greater lengthening for nonoperative treatment, although tensile properties remained the same. Conversely, Thermann et al.<sup>26</sup> found an identical lengthening to 120% in all three treatment groups (suture, fibrin glue, or dorsiflexion-blocking orthosis) at 2 to 3 months after Achilles tenotomy in rabbits. Mortensen et al.<sup>16</sup> found tendon lengthening of 9 to 11 mm. Nyström and Holmlund<sup>21</sup> found 10 to 12 mm lengthening in a study that used metallic markers and radiologic follow-up to assess tendon lengthening in patients after operative treatment. Our estimates of 10 mm average tendon lengthening in both groups correlated well with these values.

Although the total cost of each treatment was not calculated, it seems that nonoperative treatment was less expensive than operative treatment in our series because the rate of major complications was comparable. This presumed difference would probably be minimal if modern outpatient percutaneous repair had been performed in our operative group. Wills et al.,<sup>30</sup> in their overview, stated that the difference in cost was probably not significant because the cost of treatment of complications had to be included. However, the cost of absence from work needs to be considered as well. In the overview of Cetti et al.,<sup>4</sup> the sick leave periods are shown in the range of 8 weeks for nonoperative and 10.5 weeks for operative treatment. McComis et al.<sup>14</sup> state that their patients treated nonoperatively missed only 4 days of work. Our patients missed an average of 3.9 weeks of work in the nonoperative and 5.7 weeks in the operative group. However, the two groups happened to be very heterogeneous with regard to the type of occupation, although we had not excluded any patients because of their workload. In the nonoperative group, two-thirds of the patients had medium or heavy work to do, which was not possible in a high-heeled boot. In the operative group, three-quarters of the patients were white-collar workers who should be able to return to work much sooner, whatever the type of treatment. Nevertheless, the difference in our study was significantly in favor of nonoperative treatment for this latter group of workers. It might have been even greater, if the type of work performed had been comparable in both groups.

Cetti et al.,<sup>4</sup> as well as Wills et al.,<sup>30</sup> stated in their overview of the literature that the results of tests for functional recovery were better in the operatively treated

patients. Clinical as well as machine tests have shown no statistically significant difference in plantar flexion strength and endurance between our groups.

In conclusion, patients with an acute closed rupture of the Achilles tendon treated nonoperatively according to our protocol had functional results and a rate of complications comparable with those of an earlier similar group of patients treated operatively. Both groups were allowed to bear full weight as soon as tolerated, in a boot or walker. Subsidence of pain, return of function, and return to work were faster in the nonoperative group. Two types of reruptures were identified in the nonoperative group: traumatic reruptures and fatigue-type reruptures. Fatigue-type reruptures occurred in patients with compromised early tendon healing, which can be identified by careful reexamination of the tendon 7 to 10 days after the rupture. In compromised tendon healing, operative repair should be advised or the protection period should be extended.

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