

# COMBINED CONSERVATIVE AND ORTHOTIC MANAGEMENT OF ACUTE RUPTURES OF THE ACHILLES TENDON

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**Background:** There has been considerable debate about the best treatment for acute rupture of the Achilles tendon. At our institution, a well-documented and structured program of nonoperative management of Achilles tendon rupture with use of casts and a removable orthosis was developed.

**Methods:** We assessed the results in 140 consecutive patients with a complete rupture of the Achilles tendon who had been treated with our nonoperative regimen at our center between 1992 and 1998. Patients were evaluated on the basis of the subjective results and clinically with physiological testing.

**Results:** Overall, 56% of our patients had an excellent result; 30%, good; 12%, fair; and 2%, poor. The overall complication rate was 8%, with three complete and five partial tendon reruptures, two deep vein thromboses, and one temporary dropfoot.

**Conclusions:** The results of our nonoperative orthotic treatment were better overall than published results of operative repair of acute Achilles tendon rupture. Our patients were quite satisfied with their treatment.

**Level of Evidence:** Therapeutic study, Level IV (case series [no, or historical, control group]). See Instructions to Authors for a complete description of levels of evidence.

There has been considerable debate regarding the best treatment of acute ruptures of the Achilles tendon. Authors supporting operative intervention have suggested that the normal tension and length of the tendon can be restored only under direct visualization during an open repair<sup>1-4</sup>. Open repair is also thought to be associated with a lower rate of rerupture and to allow an earlier return of ankle movement following removal of the cast. The disadvantages of surgical intervention include morbidity from wound problems and anesthesia as well as higher costs.

Studies of treatment of Achilles tendon ruptures have generally dealt with small numbers of patients, and the results of surgical management have been reported more frequently than have those of nonoperative treatment. To our knowledge, only three prospective, randomized trials have been published to date<sup>5-7</sup>, and in both of those studies as well as in others that we have reviewed<sup>5,6,8-10</sup>, classic immobilization in a plaster cast was employed.

McComis et al.<sup>11</sup> developed the concept of functional bracing as an alternative conservative treatment for ruptured Achilles tendons. The brace allowed immediate weight-bearing and active plantar flexion but limited dorsiflexion of the ankle. McComis et al. found encouraging results after using this regimen for a small number of patients (fifteen).

Results have been difficult to compare directly as there has been no widely accepted scoring system with which to assess both subjective and objective outcomes. Leppilahti et al.<sup>12</sup> addressed this issue by modifying the criteria of Boyden et al.<sup>13</sup> to create a point system to record pain, stiffness, muscle weakness, footwear restrictions, range of motion, subjective outcome, and isokinetic muscle strength. They used this system to rate the outcomes in a surgically treated group, and reported that 79% had an excellent or good result.

We developed a combined conservative and orthotic treatment protocol for acute ruptures of the Achilles tendon. This regimen combines the advantages of a removable orthosis with those of traditional nonoperative therapy. The early results, in the first thirty-two patients to be treated with the regimen, were encouraging<sup>14</sup>.

This paper will outline our treatment protocol; describe how we assessed the subjective, objective, and functional results of the regimen in 140 patients, and compare those results with published surgical outcomes.

## Materials and Methods

Acute Achilles tendon ruptures were diagnosed clinically by one orthopaedic consultant. The patients had been referred to the central orthopaedic service for the province and included

**TABLE I Results of Subjective Assessment (N = 140)**

	None	Mild	Moderate	Severe
Pain	109 (78%)	18 (13%)	11 (8%)	2 (1%)
Stiffness	77 (55%)	57 (41%)	4 (3%)	2 (1%)
Weakness	79 (56%)	46 (33%)	14 (10%)	1 (1%)
Footwear limitations	117 (84%)	20 (14%)	3 (2%)	0 (0%)

all patients referred to our institution because of an acutely ruptured Achilles tendon during the period of this study. In all cases, a short leg cast was applied with the ankle in the equinus position within twenty-four hours after the diagnosis. At about two weeks, a cast was made for the fabrication of a rigid polypropylene double-shell patellar-tendon-bearing orthosis and the equinus cast was changed to a lightweight equivalent. After a total of four weeks of cast immobilization (during which time the patients remained non-weight-bearing), the patients were fitted with the removable orthosis, which was worn for another four weeks. The patients were asked to remove the orthosis when they went to bed at night, for bathing, and to allow active exercise of the ankle and subtalar joints while seated. At this stage, the patients received gait-training with advice to progress to full weight-bearing using the orthosis.

After removal of the orthosis at the eight-week point, the patients received additional physiotherapy and were encouraged to return gradually to normal activities as appropriate.

All subjects who had been treated with this regimen were invited to participate in this detailed evaluation. Each completed a questionnaire that requested information on pre-injury and postinjury work, preinjury and postinjury activity levels, time to return to work and other activity, medical history, drug history, history of Achilles tendon injury and treatment, treatment complications, and details of physiotherapy. Questions were also asked about pain, stiffness, subjective calf-muscle weakness, footwear restrictions, and satisfaction with the result of the treatment.

The patients were invited to attend a physiotherapist-led review clinic where various physiological measurements were made. The bilateral active and passive ranges of ankle and foot plantar flexion, dorsiflexion, inversion, and eversion were recorded while the patient was lying supine with the knee extended. The calf circumference was measured bilaterally 10 cm distal to the apex of the tibial tubercle with the patient standing.

The patients then warmed up with a ten-minute ergometric cycle followed by three sets of thirty-second stretches of the gastrocnemius and soleus muscles while they were standing. Peak torques (in newton-meters) were recorded for plantar flexion and dorsiflexion strengths at speeds of 30°, 90°, and 240°/sec, on both the injured and the uninjured side, with use of a Kinetic Communicator (KinCom) dynamometer (Chattecx, Chattanooga, Tennessee). The testing position was supine with the knee extended. Before testing, the patients performed some minimal, submaximal, and maximal repetitions, at a velocity of 30°/sec, with each leg. They were given a five-minute rest period before testing, a one-minute rest

period between each contraction, and a five-minute rest period between each leg. Three maximum voluntary contractions were required at each speed.

The paired t test was used to calculate the significance of the differences in the continuous variables between the injured and uninjured legs. Approval was obtained from the Research Ethical Committee of the University of Ulster, Jordanstown, and the Research and Development Committee of Greenpark Healthcare Trust, Belfast.

## Results

One hundred and forty consecutive patients (101 men and thirty-nine women), with a mean age of forty-five years (range, twenty-seven to seventy-nine years), were evaluated. The mean duration of follow-up was 2.9 years (range, 0.4 to 8.2 years). The rupture was on the left in seventy-two patients and on the right in sixty-eight. The mean time between the injury and treatment was twenty-two hours (range, one hour to 17.5 days).

Before the injury, 28% of the patients had a desk job, 28% had a job requiring physical labor, 31% had a professional occupation, and 13% were unemployed. The mean time lost from work was seven days (range, zero to fifty-two days), and 98% of the patients who had been working before the injury returned to their full preinjury level of employment. No patient was involved in a compensation claim.

Before the injury, 42% of the patients played sports regularly (two or more times a week), 30% occasionally took part in sports activity (approximately once a week), 25% were active but did not play a sport, and 3% were housebound. Of the patients who had engaged in sports activity before the injury, 4% returned to a better level of activity after treatment, 33% returned to the same level, 54% returned to less sports activity, and 9% were unable to return to sports activity. The mean time until the return to sports activities following removal of the orthosis was eight weeks (range, two weeks to six months).

The results of the subjective questionnaires and the patients' overall satisfaction with the treatment are shown in Tables I and II.

**TABLE II Overall Satisfaction with Result of Management Regimen (N = 140)**

Very satisfied	116 (83%)
Satisfied with minor reservations	21 (15%)
Satisfied with major reservations	2 (1%)
Dissatisfied	1 (1%)

**TABLE III Mean Active Range of Ankle Motion, Calf Circumference, and Peak Ankle Torques on the Injured and Uninjured Sides**

	Injured	Uninjured	P Value
Active dorsiflexion ( <i>deg</i> )	22.0	21.1	<0.05
Active plantar flexion ( <i>deg</i> )	26.4	27.1	<0.05
Calf circumference ( <i>cm</i> )	35.4	36.6	<0.05
Peak torque ( <i>N-m</i> )			
30°/sec	137.9	158.7	<0.05
90°/sec	91.2	101.2	<0.05
240°/sec	60.3	64.3	<0.05

The active ranges of dorsiflexion and plantar flexion, the calf circumference, and the plantar flexion peak torque values are shown in Table III. There were small but significant differences between the injured and uninjured legs with regard to all of those variables.

A comparison of the results in our patients with those in the surgically treated patients in the study by Leppilahti et al.<sup>12</sup> is shown in Table IV.

The major complications included three complete reruptures, which occurred three months after the injury in two patients and nine months after the injury in one. All of these reruptures were forced-dorsiflexion injuries: two of the patients stumbled on steps, and one stumbled on cobblestones while wearing high-heeled shoes. All of the patients were treated nonoperatively again, with an excellent overall result (Leppilahti score).

The minor complications included a partial rerupture (as judged by the senior author, R.G.H.W.) in five patients, deep venous thrombosis in two, and a temporary dropfoot in one. Three of the partial reruptures occurred in the first two months after the injury, in patients who did not comply with the instructions on wearing the orthosis. The other two partial reruptures occurred three months after the injury: one of them resulted when the patient tripped, and the other occurred spontaneously for no apparent reason. These reruptures were considered to be partial because the patients were found, on assessment, to have moderate active plantar flexion of the ankle that was greater than what would be expected from recruitment of the secondary plantar flexors alone. The patients were treated for an additional four to six weeks with the orthosis only. Three had an excellent overall result (Leppilahti score); one, a good result; and one, a fair result. The dropfoot lasted less than three months and was probably the result of pressure on the common peroneal nerve resulting from a fall while the patient was wearing the initial plaster cast. The patient made an excellent recovery.

## Discussion

The prevalence of Achilles tendon rupture is rising. Most authors have concluded that surgery is the treatment of choice<sup>5,15</sup>, with nonoperative management reserved mainly for elderly or more sedentary individuals.

Generally, the literature has shown that operative repair

produces better functional results, with a lower rerupture rate, than does nonoperative management. Operative repair also has a higher rate of complications<sup>16</sup>. While the nonoperative approach may result in a poorer functional result, some authors have noted that many of the postoperative complications can be avoided<sup>17</sup>.

There have been few randomized, controlled trials comparing the two types of management<sup>5,7</sup>. The most recent prospective study of which we are aware<sup>7</sup> showed a significantly lower rate of rerupture ( $p < 0.001$ ) in an operatively treated group (1.7%) than in a nonoperatively treated group (20.8%). In that trial, the nonoperative treatment was static, consisting of eight weeks of immobilization in a cast, but a functional

**TABLE IV Comparison of Results\* in Our Conservatively Treated Group with Those in the Surgically Treated Group in the Study by Leppilahti et al.<sup>12</sup>**

Result	Percentage of Patients	
	Surgical Group <sup>8</sup>	Conservative Group
Overall		
Excellent	34	56
Good	46	30
Fair	17	12
Poor	3	2
Isokinetic strength		
Excellent		33
Good	71	38
Fair	18	22
Poor	11	7
Plantar flexion strength deficit		
30°/sec	11	13
90°/sec	10	10
240°/sec	2	6
Complication rate		
Major	7	2
Minor	20	6

\*According to the scoring system of Leppilahti et al.<sup>12</sup>.

bracing regimen was used for the surgically treated patients.

Other comparative studies have included heterogeneous groups of patients, and consequently the results have been difficult to evaluate<sup>8,9,18-20</sup>. Also, the lack of a universally accepted and consistent scoring protocol for the subjective and objective evaluation of Achilles tendon rupture has made direct comparison of results between articles extremely difficult.

In the majority of previous studies of nonoperative management<sup>5,6,8-10</sup>, the patients were treated with rigid cast immobilization. Functional bracing may improve the results of conservative treatment. A few small reports on conservative functional management have been published<sup>11,14,20-22</sup>, but additional studies are needed to assess potential risks and benefits. The current investigation is the largest study to date to review conservative functional management, and it was designed to allow direct comparison of its results with those in a surgically managed group—i.e., the patients in the study by Leppilahti et al.<sup>12</sup>, who used a protocol for subjective and objective evaluation of Achilles tendon rupture. Such a direct comparison was not possible before, as no scoring scale was available.

The overall score was excellent in 56% of our patients, good in 30%, fair in 12%, and poor in 2%. These results were better than those reported by Leppilahti et al.<sup>12</sup> (Table IV). Pain was not a common problem; only one subject, who had generalized osteoarthritis, still had severe pain at time of the latest follow up. Mild stiffness in the morning and mild stiffness after recreational activities were common symptoms and were also reported by Leppilahti et al.<sup>12</sup>.

Mild-to-moderate weakness was experienced only with recreational or sports activities; the one individual who had severe weakness previously had been very active and reported that she had not returned to sports because she was afraid of a rerupture.

We found very small differences in ankle range of motion between the injured and uninjured limbs, with slightly increased dorsiflexion and reduced plantar flexion on the injured side. Our patients had smaller changes in the range of motion than did the patients treated operatively in the study by Leppilahti et al.<sup>12</sup>. Similar changes in the range of motion have been reported by others, following both surgical and nonsurgical management, and may be a standard consequence of the injury, regardless of the treatment method<sup>23</sup>. McComis et al.<sup>11</sup> stated that, although increased dorsiflexion has been associated with increased Achilles tendon length after rupture, its relationship with decreased force-generating capabilities of the ankle-joint complex has not been established. They found no decrease in plantar flexion strength of the ankle following brace treatment of acute ruptures.

In our series, the mean plantar flexion strength (as compared with that on the contralateral, uninjured side) at both low and high speeds was similar to that reported by Leppilahti et al.<sup>12</sup> in their surgically treated patients. However, Kuwada<sup>24</sup> stated: "Plantarflexory strength can be tested against resistance, but this may not reveal the entire clinical picture. The patient's own perception of strength and function is most important." In our study, 89% of the subjects had no or mild

subjective symptoms of calf muscle weakness. Thus, the concern expressed by advocates of surgical treatment that lengthening of the tendon can lead to a clinically important decrease in strength has not been substantiated and should not be considered a reason for surgical treatment.

Early return to work is a well-known benefit of nonoperative management. In previous reports, the mean time lost from work has ranged from 10.5 to thirteen weeks after operative treatment and from 8.5 to nine weeks after nonoperative treatment<sup>5,6,25</sup>. In the present study, the mean time lost from work was only seven days (range, zero to fifty-two days). Differences of this magnitude can have an important economic impact on both the patient and the health-care system.

The subjects in this study returned to sports activity in a mean of only eight weeks following conclusion of the treatment. Four percent returned to a higher level of activity, 33% returned to the same level, 54% returned to a lower level, and 9% were unable to return to sports for various reasons. In the study by Leppilahti et al.<sup>12</sup>, 73% returned to the same level of sports activity, 4% returned to a lower level, and 23% retired. Most of their subjects were competitive and recreational athletes, and no information was given on their rehabilitation or on the time required for a return to sports. This injury typically occurs at an age when many individuals are reducing their level of sports activity, so there is not always a strong motivation to return to sports following recovery. However, the higher rate at which the surgically treated patients returned to sports activity requires further study.

The rate of reruptures following conservative management has been the central point of debate in discussions of alternative forms of treatment. Rerupture rates as high as 17.7%<sup>26</sup> following nonoperative management have been mentioned as evidence that surgical management is the better treatment option. Lo et al.<sup>17</sup> found that, while data regarding complications were missing from certain studies, the frequency of rerupture was four times higher for nonoperatively managed patients ( $p < 0.001$ ) but the total rate of complications for those patients was only one-seventh of the rate for those treated operatively.

In our study, three patients had a rerupture, so the rate of major complications was 2%. Minor complications (those that delayed recovery but did not influence the overall study results<sup>10,27</sup>) occurred at a rate of 6% and included five partial reruptures, two deep venous thromboses, and one temporary dropfoot. Three of the five partial reruptures were due to noncompliance with the prescribed treatment regimen. While noncompliance would not have occurred with full cast immobilization, the number of complications resulting from noncompliance was low. Our complication rates were much lower than those reported by Leppilahti et al.<sup>12</sup> (7% and 20%, respectively) in their study of surgically managed patients.

In conclusion, it is our strong view that our nonoperative treatment protocol for rupture of the Achilles tendon should be the treatment of choice, but only when supervised by senior, experienced staff. Some problems have come to light when patients were managed in other hospitals by staff with insufficient experience with this form of treatment, rein-

forcing the importance of experienced input in the care of this injury. ■

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