

Early Weightbearing and Ankle Mobilization after Open Repair of Acute Midsubstance Tears of the Achilles Tendon

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Purpose: To study the effects of early weightbearing and ankle mobilization after acute repair of ruptured Achilles tendon.

Study Design: Comparative longitudinal study.

Methods: Patients in group 1 were postoperatively immobilized with their ankle in gravity equinus, they were encouraged to bear weight on the operated limb as soon as possible to full weightbearing, and they received a single cast change at 2 weeks, with the ankle accommodated in an anterior splint in a plantigrade position, allowing the ankle to be plantar flexed fully but not dorsiflexed above neutral. Patients in group 2 were immobilized with their ankle in full equinus with a cast change at 2 weeks, when the ankle was immobilized in mid equinus, and at 4 weeks, when the ankle was immobilized in a plantigrade position, and they were advised to bear weight.

Results: Patients in group 1 attended fewer outpatient visits, completely discarded their crutches at an average of 2.5 weeks, and more were satisfied with the results of surgery. At ultrasonography, the average thickness of the repaired tendon was 12.1 mm, with no difference in the thickness of the ruptured tendon regardless of postoperative management. There was no significant difference in isometric strength between the two groups.

Conclusions: Early weightbearing with the ankle plantigrade is not detrimental to the outcome of repair after acute rupture of the Achilles tendon and shortens the time needed for rehabilitation. However, strength deficit and muscle atrophy are not prevented.

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Achilles tendon ruptures are common,²⁴ but there is no agreed protocol for their management.^{18,19,40} In general, most surgeons in the United Kingdom and continental Europe would opt for operative management followed by below-the-knee cast immobilization in physically active patients.¹⁸ The cast is applied with the ankle in plantar flexion for 2 weeks, during which patients remain non-weightbearing. At 2 weeks, the cast is removed, the wound examined, and another nonweightbearing cast with the

ankle in less equinus is applied for a further 2 weeks. At 4 weeks from the operation, the cast is again changed, the ankle is positioned so that the foot is plantigrade, and weightbearing is begun. The cast is removed at 6 weeks. We have obtained good and reliable results with this regimen.⁵

When a repaired tendon is subjected to tension during healing,^{32,33} orientation of collagen fibers, strength of the calf muscles, breaking strength of the tendon, number of collagen filaments, and tendon vascularity are all improved.^{6,10,31} After Achilles tendon rupture repair, early weightbearing may limit atrophy and stiffness, but it may also place abnormal, deleterious stresses on the repair. We have recently shown that early weightbearing with the foot plantigrade—although a controversial position^{2,36}—produces good results after surgical repair of

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acute Achilles tendon ruptures.²³ Allowing early ankle motion after Achilles tendon rupture repair is popular in North America.^{13,25,27,28,35} In the present investigation, we wished to ascertain whether after open Achilles tendon rupture repair, early weightbearing and limited ankle mobilization allowed faster recovery than the classic method of immobilization for 6 weeks, allowing weightbearing from the 4th postoperative week. We used a comparative longitudinal study design for our investigation.

PATIENTS AND METHODS

Ethics

All of the procedures described in this study were performed after local Ethical Committee approval had been granted by the Grampian University Hospital Trust. Written informed consent was given by all patients included in this study.

Based on our previous work,^{5,30} a preliminary power analysis showed that 19 patients per each group would be sufficient to have an 80% chance to detect a 5% difference in strength, return to activities, and anthropometric measurements between traditional postoperative management and early weightbearing and limited ankle mobilization after open repair of an Achilles tendon rupture. To build some redundancy in the study, we decided to recruit at least 25 patients in each group.

Patients

All operations were performed in the period January 1998 to June 1999. In all patients, a diagnosis of midsubstance subcutaneous tear of the Achilles tendon was made clinically and confirmed at surgery. Patients were counseled on the advantages and disadvantages of operative versus nonoperative management, and those who opted to be treated operatively entered the study. We excluded from this investigation patients with open Achilles tendon lesions, patients whose tear had occurred more than 7 days before the operation, patients who received a percutaneous repair of their Achilles tendon rupture, patients with diabetes or inflammatory disease, and patients who were taking systemic corticosteroids or fluoroquinolones.

Patients were allocated to one or the other mode of treatment (described later) according to the day of the week when they came to our institution for care.

Age, sex, side injured, operative details, anesthetic technique, operating times were recorded. Mode of injury is presented in Table 1. The two groups of patients were well matched for age at injury and levels of activity before the injury. Group 1 had 22 men and 4 women aged from 31 to 69 years at the time of injury (average age, 44.7 years); there were 11 right-sided and 15 left-sided ruptures. Group 2 had 23 men and 4 women aged from 30 to 67 years at the time of injury (average age, 43.8 years); there were 11 right-sided and 16 left-sided ruptures. All patients were operated on within 48 hours of admission to our department. Fifteen patients were operated on the day of rupture, 29 the day after, and the remaining 9 patients

TABLE 1
Activity at the Time of Rupture

Activity	Group 1 (N = 26)	Group 2 (N = 27)
Soccer	6	5
Indoor soccer	3	4
Racquet games (tennis, squash, badminton)	10	9
Running	3	2
Dancing	1	3
Accident at home	2	2
Accident at work	1	2

were operated on 2 days after rupture. Patients in group 1 were operated on at an average of 1.6 days from the index injury and patients in group 2 were operated on at an average of 1.7 days from the index injury.

Operative Technique

Patients were operated on using a previously described open technique.³⁷ At operation, all patients had a complete midsubstance tear of the Achilles tendon, 2 to 6 cm proximal to its insertion on the calcaneus. The plantaris tendon was present in 16 patients in group 1 and in 22 patients in group 2. On no occasion was it ruptured. An end-to-end repair was performed with a single modified Kessler suture, extending just proximal to the Achilles tendon insertion distally and just distal to the musculotendinous junction proximally. The suture material used was either No. 1 Vicryl (Polyglactin 910 braided absorbable suture, Ethicon, Johnson & Johnson, European Logistics Centre, Brussels, Belgium) (46 patients) or No. 1 polydioxanone (Ethicon W9234T) (7 patients).

The repair was tensioned to reproduce the physiologic minimal equinus present in the opposite ankle. A running circumferential suture with 3–0 Vicryl reinforced the core suture.¹⁹ The repair was thicker than the original tendon, and the paratenon, even when viable, could not always be sutured over it. Continuous 4–0 Vicryl reabsorbable sutures were used for the subcutaneous fat, and the skin was closed with interrupted 4.0 Ethilon (Ethicon, Johnson & Johnson) (11 patients) or with a subcuticular 4–0 Vicryl reabsorbable suture (42 patients). The skin wound was dressed with gauze, and sterile plaster wool was applied, followed by a below-the-knee synthetic (group 1) or plaster of Paris (group 2) cast without increasing the natural minimal equinus of the ankle.

When the cast had dried, patients were encouraged to mobilize with the use of crutches, under the direction of a physical therapist. Patients were discharged within 3 days after the operation (average, 1.8 days for both groups), after having been taught to use crutches by an orthopaedic physical therapist.¹⁹

Postoperative Care

Group 1. Patients were allowed to bear weight on the tip toes of the operated leg as tolerated, but they were told to keep the leg elevated as much as possible for the first 2 postoperative weeks.¹⁹ The cast was removed 2 weeks

after the operation, when the skin sutures, if used, were removed. The ankle was positioned plantigrade. A synthetic anterior below-the-knee slab was applied, with the ankle in neutral position. The synthetic slab was secured to the leg with three or four removable VELCRO (VELCRO USA Inc., Manchester, New Hampshire) straps for 4 weeks (Fig. 1). These patients were encouraged to bear weight on the operated limb as soon as they felt comfortable, and to gradually progress to full weightbearing. The patients were seen by a trained physical therapist who taught them to perform gentle mobilization exercises of the ankle, isometric contraction of the gastrosoleus muscle complex, and gentle concentric contraction of the calf muscles. Patients were encouraged to perform mobilization of the involved ankle several times per day after unstrapping the two most distal straps (Fig. 1). Patients were given an appointment 6 weeks from the operation, when the anterior slab was removed.^{10,12}

Group 2. Patients were told not to bear weight on the operated leg and were encouraged to keep the leg elevated as much as possible for the first 2 postoperative weeks. The cast was removed at 2 weeks after the operation, when the skin sutures, if used, were removed. The ankle was plastered in a more plantigrade position and the patients were reviewed 4 weeks after the operation, at which time the ankle was put in a synthetic cast as close to plantigrade as possible. At this stage, patients were encouraged to increase their weightbearing as much as possible, with a view to discarding their crutches as soon as possible. Patients were given an appointment 6 weeks from the operation, when the cast was removed.

Postoperative Care after Removal of the Cast (Both Groups)

After 6 weeks, patients mobilized the ankle under physiotherapy guidance, unless they had already been discharged from physiotherapy (see later in "Discussion"). Patients in group 2 were seen by a trained physical therapist who taught them to perform gentle mobilization exercises of the ankle, isometric contraction of the gastrosoleus muscle complex, and gentle concentric contraction of the calf muscles. They were allowed to bear weight as able and commenced gradual stretching and strengthening exercises.¹⁹ Cycling and swimming were started 2 weeks after removal of the cast in patients from group 2, and as soon as possible in patients from group 1. Patients were prompted to increase the frequency of their self-administered exercise program and were told that they could return to their sport on the 5th postoperative month. A heel raise was not routinely used unless the ankle had not been positioned in a plantigrade position after the change of cast at 4 weeks. This occurred in four patients, all in group 2, in whom a plantigrade position had not been reached at that stage because of pain. These four patients kept a 1.5-cm heel raise for 4 weeks after removal of the cast.

Follow-Up

At the time of discharge from the hospital after the operation, all patients were given an appointment for review 2 weeks postoperatively (OPD1). At OPD2 (4 weeks postoperatively, only for patients in group 2), the plaster of Paris cast was removed, the wound was again inspected, and a synthetic below-the-knee cast was applied, with the ankle 15° short of neutral. At OPD3 (6 weeks postoperatively, all patients), the cast was removed and the patient referred to physiotherapy for active mobilization. At OPD4 (10 or 12 weeks postoperatively), patients were assessed as to whether they were able to undertake more vigorous physiotherapy. Further follow-ups at 14 weeks (OPD5) and 18 weeks (OPD6) were arranged.

Patients were reviewed during the 6th postoperative month. They were then followed up at 3-month intervals and discharged at 9 or 12 months after the operation, once they were able to perform at least five toe raises unaided on the operated leg and after they returned to their work or sport. Patients were prompted to contact the operating surgeon should any problems arise at any time after the operation.

Patients were reviewed in a special clinic over 4 consecutive weeks after an average of 21 months (range, 16 to 26; SD, 4.6) after the operation. Eight patients (four in each group) did not attend the follow-up sessions: two had died of cardiovascular causes and the others were untraceable, having moved away from our area. Trainees who had not been involved in and were not aware of the patients' initial management assessed all of the patients.

Anthropometric Measurements

The maximum calf circumference was measured in both the affected and the contralateral leg by using a commercially available steel tape measurer.¹² The measurer was able to reproduce within 5% the duplicate measurements on the same calf.^{20,22} All measurements were taken at the special clinic.

Classification of Results

The outcome of surgical management was rated on a validated four-point scale³ as excellent, good, fair, or poor (see also Table 4).

Isometric Gastrosoleus Muscle Strength

Isometric plantar flexion strength of the gastrosoleus muscle complex was determined bilaterally at two fixed ankle positions, neutral (0°) and 10° of dorsiflexion, by using a custom-made apparatus.^{21,23,38} The apparatus consists of a footplate, the angle of which could be varied and locked into a given position. An analog-to-digital converter (ADC-10, PICO Technology, Cambridge, United Kingdom) connected the strain gauge on the footplate to a voltmeter (Picoscope, PICO Technology). In its turn, the voltmeter was connected to a computer. The changes in voltage were then converted into Newtons to measure

strength. The apparatus was calibrated by suspending known weights from 2.5 to 37.5 kg before and after each patient was tested, giving a linear response.

Each patient supported the lower limb in the leg rest, with the heel placed firmly at the top of the footplate and with the plantar aspect of the foot resting at ease. The



Figure 1. The synthetic anterior below-the-knee slab was applied and secured to the leg with three or four removable VELCRO straps. Patients were able to mobilize the ankle several times per day after unstrapping the two most distal straps. A, a patient fully bearing weight while wearing the synthetic slab; B, close-up of the synthetic anterior below-the-knee slab showing the plantigrade foot position and the positioning of the VELCRO straps; C, unstrapping the straps allows the patient to perform concentric exercises of the gastrosoleus muscle complex against manual resistance; D, with the straps unfastened, the patient can perform unaided mobilization of the ankle within the limits imposed by the synthetic slab, thus preventing overstretching of the repaired Achilles tendon.

patient was then asked to exert maximal isometric force on the footplate for 3 to 5 seconds. The maximum result was noted. The amplifier was used each time to return the voltmeter to 0. Each patient performed two maximal attempts at each angle, and the average was used for further analysis. For technical reasons, we were not able to measure isometric strength in 2 of the 21 patients in group 1 who attended for the final follow-up visit, and in 3 of the 21 group 2 patients who attended the final follow-up visit.

High-Resolution, Real-Time Ultrasound Assessment

High-resolution, real-time ultrasound assessment was performed bilaterally on all patients attending the final follow-up visit (21 patients in group 1 and 21 patients in group 2) by a single fully trained radiologist (RB) with a special interest in musculoskeletal imaging using a Hitachi EUB 555 ultrasound machine (Hitachi Medical Systems Europe Holding AG, Zug, Switzerland) equipped with a 10-MHz linear array footprint transducer. All subjects were scanned in the prone position with their feet hanging over the edge of the examination couch.²¹ The ankles were held in the relaxed neutral position. No stand-off medium was used. The Achilles tendons were examined in the longitudinal and transverse planes, with special care being taken in placing the transducer to ensure that the ultrasound beam was perpendicular to the tendon to avoid anisotropy. We measured the widest anteroposterior tendon diameter and evaluated the intratendinous ultrasonographic appearance by assessing the presence of hypo- or hyperechogenic areas.

Questionnaire

Each patient completed a questionnaire to determine satisfaction, effect on occupational and sporting activities since rupture, and a pain score validated for tendon problems adapted from Victorian Institute of Sport Assessment VISA-A.³⁴

Statistics

Data were entered in a commercially available database. Descriptive statistics were calculated. The groups were compared by using the 2×2 contingency table test for binary outcomes and the Wilcoxon two-sample test for continuous outcomes. Comparisons between the operated and the normal limbs from the same person were performed with the McNemar's test to analyze binary data, and the Wilcoxon test was used on the difference in scores for continuous data. Significance was set at the 0.05 level. The paired-samples *t*-test was used to compare the isometric gastrosoleus muscle strength in the ruptured side with the nonruptured side. The two-sample *t*-test was used to compare the differences between the groups.

RESULTS

Postoperative Course

All patients were able to bear weight fully on the affected limb by the 10th postoperative week. Patients in group 1 discarded their crutches at an average of 2.5 weeks (range, 1.2 to 3.1; SD, 0.4) from the operation, although most patients stated that they had stopped using the crutches in the home for at least 1 week before discarding them altogether. Patients in group 2 discarded their crutches at an average of 5.5 weeks (range, 4.6 to 8.1; SD, 2.2) from the operation ($P = 0.021$). Four patients (two in each group) had a superficial infection of the surgical wound. They received oral antibiotics for 5 days, were asked to keep the leg elevated at all times, and healed uneventfully by OPD4. At OPD4, nine patients (four in group 1) complained of hypersensitivity of the surgical wounds. They were counseled to rub hand cream over the wounds several times a day, and all were asymptomatic by the next visit. One patient in group 1 developed a hypertrophic scar in the area of the wound as it rubbed against the shoe and was not pleased with the appearance of the operative scar. No patients developed a deep vein thrombosis or sustained a rerupture.

The number of outpatient visits varied from 4 to 11 (average, 7.1), with significantly fewer visits in group 1 patients (6.1 ± 3 versus 8.5 ± 3.3 , $P = 0.027$).

Patients in group 1 received an average of 6.1 physiotherapy sessions (range, 2 to 11; SD, 3.1) and were discharged from physiotherapy at an average 2.1 months (range, 1.8 to 5; SD, 1.1) from the repair. Patients in group 2 received an average of 13.6 physiotherapy sessions (range, 8 to 26; SD, 4.8) and were discharged from physiotherapy at an average 4.6 months (range, 4 to 9; SD, 2) from the repair ($P = 0.03$).

On clinical examination, the operated tendon was thicker than the contralateral limb in all patients. No patient complained about the abnormal appearance of the operated tendon.

Anthropometric Measurements

The maximum calf circumference was significantly decreased in the operated limb (overall: 39.1 ± 5.4 cm versus 41.3 ± 7 cm, $P = 0.034$), with greater circumference in group 1 patients (40.3 ± 6.4 cm versus 38.1 ± 7.7 cm, not significant).

Functional Assessment

Although a greater proportion of patients in group 1 had excellent or good results, the difference was not statistically significant and there were remarkably few poor results in either group (Table 2). All but four patients, all aged above 62, were able to perform five single-legged toe raises at the review clinic.

TABLE 2
Clinical Results of Open Repair of Achilles Tendon Rupture^a

Result	Group 1 (N = 26)	Group 2 (N = 27)
Clinical evaluation		
Pain		
None	23	24
Mild, occasional	2	2
Moderate	1	1
Severe	0	0
Activity limitations		
None	24	25
Limited recreational but not daily activities	2	2
Limited recreational and daily activities	0	0
Footwear restrictions		
None, mild (most shoes tolerated)	25	25
Moderate (unable to tolerate fashionable shoes, with or without insert)	1	2
Severe (only modified shoes tolerated or brace)	0	0
Satisfaction		
Satisfied	23	23
Satisfied with minor reservations	3	4
Satisfied with major reservations	0	0
Dissatisfied	0	0
Overall results		
Excellent	23	22
Good	2	3
Fair	1	2
Poor	0	0

^a For patients who were not able to attend the final follow-up, the result at their last outpatient appointment is reported.

Isometric Strength

The duplicate measurements showed a high intraobserver reliability ($r = 0.92, P = 0.002$). The *t*-test paired statistics showed that the operated limb was always less strong than the nonoperated one, at both neutral ($P = 0.042$) and 10° of dorsiflexion ($P = 0.05$) (Table 3). There was no statistically significant difference on the operated side between the patients in group 1 and in group 2 ($P = 0.07$); however, the isometric strength on the operated side was higher in group 1 patients.

Ultrasonographic Assessment

The coefficient of variation of repeated measurements of the anteroposterior diameter of the tendon was 1.7%. The average anteroposterior diameter of the ruptured tendon was 11.9 mm (SD, 2), with no difference in the ruptured tendons regardless of the method of postoperative management. The patients' contralateral tendon measured an average of 5.4 mm (SD, 1; $P = 0.001$). Seven patients (four in group 1 and three in group 2) had calcifications in their

TABLE 4
Patient Satisfaction with the Outcome of Achilles Tendon Repair^a

Group	Excellent	Good	Satisfactory	Poor
1 (N = 26)	16	7	3	0
2 (N = 27)	13	5	7	2

^a For patients who were not able to attend the final follow-up, the result at their last outpatient appointment is reported.

ruptured tendon. Two patients (both in group 2) showed areas of hypoechogenicity in their unruptured contralateral tendon.

Patient Satisfaction

Table 4 shows the results of patient satisfaction. A greater proportion of patients in group 1 were satisfied with the results of surgery ($P = 0.04$). There was no correlation between the difference in the anteroposterior diameter of the tendon and patient satisfaction ($P = 0.132$) or the patient's VISA-A score ($P = 0.51$).

Effects on Working Life

Forty-nine patients were employed at the time of their injury, three were unemployed, and one was retired (Table 5). By 12 months after the index injury, all patients employed at the time of their Achilles tendon rupture had returned to work (Table 6). Three patients changed jobs after their Achilles tendon rupture, and two of these patients stated that these changes were a direct result of the injury. Most patients reported that their injury no longer had any effect on their working lives, with only six patients (two in group 1) reporting persistent problems at work because of their injury. These difficulties were all only minor and included ankle stiffness (three patients), tiredness in the leg after standing for long periods of time (three patients), and slight pain, especially in the morning and after prolonged standing (two patients). When the two management protocols were compared for the number of patients who had returned to work, changed jobs, and still experienced problems at work as a result of their injury, no significant differences were found. The patients in group 1 with a manual job returned to work at an average of 3.2 ± 0.6 weeks, while in group 2, patients with a manual job returned to work at an average of 4.5 ± 1.1 weeks ($P = 0.041$). The patients in group 1 with a sedentary job returned to work at an average of 2 ± 0.5 weeks, while in group 2 patients with a sedentary job returned to work at an average of 3.5 ± 1 weeks ($P = 0.04$). Overall,

TABLE 3
Isometric Strength Variables (in Newtons)

Peak torque position	Group 1		Group 2	
	Operated	Nonoperated	Operated	Nonoperated
10° dorsiflexion	536.43 ± 150.17	580.5 ± 205.36	520.8 ± 160.5	574.3 ± 234.1
Neutral	250.8 ± 130.9	265.2 ± 110.6	242.2 ± 152.2	270.1 ± 133.5

TABLE 5
Work Status of Patients Before and After Injury

Group	Heavy manual		Manual		Sedentary		Unemployed		Retired	
	Before	After	Before	After	Before	After	Before	After	Before	After
1 (N = 26)	4	4	8	7	11	12	3	3	0	0
2 (N = 27)	5	4	8	7	12	14	1	1	1	1

TABLE 6
Effect of Injury on Work

Group	Employed at time of injury	Returned to work	Same job
1 (N = 26)	23	23	22
2 (N = 27)	26	26	24

patients in group 1 returned to work significantly earlier than patients in group 2 (9.2 ± 2.5 weeks versus 13.2 ± 3 weeks, $P = 0.05$).

Effects on Physical Activity

A total of 19 patients in each group took part in regular physical activity. Most patients had returned to regular physical activity by 12 months after the index injury. There were no significant differences in the rate of return to regular physical activity between the two groups (Table 7). However, the average time to return to sport was 5.1 months (range, 4.1 to 8; SD, 2.8) in group 1 patients, and 6 months (range, 4.6 to 11.2; SD, 3) in group 2 patients ($P = 0.04$).

VISA-A Scores

The average VISA-A score for all subjects was 90%, ranging from 87% to 95%, with no significant differences between the two groups. There was no statistically significant association between the VISA-A score and patient satisfaction or time since rupture. However, there was a trend for patients in group 1 to give higher VISA-A scores.

DISCUSSION

Many techniques have been described to manage acute Achilles tendon ruptures,^{7,29,37,39,40} but none has been proven to offer clear advantages, and comparative studies are lacking.^{14,17} For optimum results after surgery for Achilles tendon ruptures, the repair should be placed under early tension.^{11,12} In group 1, 2 weeks after the operation, the ankle was placed plantigrade, thus exerting

early tension. A front slab was fashioned so that the patients were able to plantar flex the ankle fully, but they could only dorsiflex it to neutral, thus preventing overstretching of the repair.

Early weightbearing and flexion and extension of the ankle impose cyclical tension and relaxation to the repaired Achilles tendon and its gastrosoleus muscle complex,²⁶ giving an appropriate stimulus to growth and repair.⁸ There have been concerns that early weightbearing may stretch the Achilles tendon rupture repair, especially if the ankle is kept in neutral. However, in a previous investigation we have shown that this is not the case,²³ and early active tension has been applied to sutured flexor tendons in the hand with no deleterious effects.⁴ We did not quantify the actual degree of equinism in the cast. In the immobilized ankle, the degree of plantar flexion and the contractile activity of the plantar flexor muscles determine the stresses imposed on the Achilles tendon.¹ In the immobilized ankle, the addition of a 2.5-cm heel lift was sufficient to minimize plantar flexor muscle activity during walking.¹ It is likely that the degree of physiologic equinus is close to that resulting from a 2.5-cm heel lift, thus markedly decreasing plantar flexor muscle activity during walking and protecting the tendon in the immediate postoperative period until the ankle is brought to a full plantigrade position.

Isometric Strength Testing

We found that isometric strength testing of the gastrosoleus muscle complex is a valid and reproducible outcome measure for recovery after surgery for Achilles tendon ruptures.²¹ We are therefore confident that any strength changes detected in the current investigation are present and real. Our subjects did not realize that they had a small strength deficit.⁹ This is in accordance with our previous studies, and we are not sure whether this might have clinical implications.²³ In the future, the addition of isokinetic testing to our strength assessment protocol could be warranted,^{15,16} together with ankle and gastrosoleus muscle-specific functional assessment.

TABLE 7
Physical Activity Participation Before and After Injury

Group	Recreational		Club		Regional		National		International	
	Before	After	Before	After	Before	After	Before	After	Before	After
1 (N = 19)	10	9	4	3	3	3	1	1	1	1
2 (N = 19)	8	8	10	8	1	1	0	0	0	0

Calf Circumference

The calf muscles rapidly atrophy after a period of immobilization after Achilles tendon rupture, and soleus muscle biopsies show selective decrease in type I muscle fibers in relation to the type IIb fibers.¹² We found that the least atrophy of the calf was seen in the patients in group 1 as compared with those in group 2, a possible effect of the greater earlier tension imparted on the gastrosoleus muscle complex by the use of a plantigrade front slab and cyclical tension on weightbearing and mobilization.

VISA-A Scores

All the subjects obtained high scores in the VISA-A questionnaire, with low levels of pain and disability. The only researchers to use another standardized scoring system have been Leppilahti and colleagues.^{15,16} However, the VISA-A questionnaire had been originally developed for Achilles tendinopathy, and its use in patients with Achilles tendon ruptures may not be appropriate.

Patient Satisfaction

Patients in both groups had little or no pain or limitation of function. However, more patients in group 1 were satisfied with the treatment received. They thought that their everyday life had not been hampered, as they had used crutches for a short time. When examining these results, it is important to consider patients' previous lifestyles. For example, the patient could have been retired when the tendon ruptured and, consequently, returning to the preinjury level of activity would have been far easier than if one were a top-ranking athlete.

Overall Outcome

Although we did not specifically investigate the economic implications of these two different regimens, group 1 patients, by undergoing one cast change instead of two, by attending fewer outpatient appointments, and by receiving less physiotherapy, consumed fewer health care resources than the patients in group 2. Also, they returned to work after an average of only 2 versus 3.5 weeks from the operation, and they were therefore less reliant on sickness benefit.

Traditionally, surgical management has been associated with a relatively high rate of complications. In this study, only a few patients developed a complication. In no case were catastrophic wound infection and skin loss experienced, there were no deep vein thromboses, and no patient sustained a rerupture. Thickening of the Achilles tendon, which is well recognized after Achilles tendon ruptures, was present in all patients.¹⁸ It did not bother our patients and was not associated with adhesions.

Limitations of the Study

Postoperative management was uniform within each group throughout the study, and the operating surgeon

was not involved in the final assessment of the patients. As is common in studies dealing with working, geographically mobile subjects, we were not able to track down all of the patients who originally entered the study.

In this study, no formal randomization was implemented. We acknowledge that the evidence for assessing postsurgical outcomes and for establishing causation is not as strong as that which would be produced by a randomized controlled trial. However, despite their limitations, such studies marry the realities of clinical practice with the rigors of scientific investigation and can be valuable for the formulation of hypotheses for future prospective, randomized trials.

Some of the differences found in this study may have been produced by the regimen employed. For example, patients in group 1 were likely to have had a lesser number of outpatient visits and of physiotherapy sessions. Nevertheless, these differences are present and actual and, in the present climate of cost savings in medical care, will increase the efficiency and effectiveness of a health system.

CONCLUSIONS

The management of acute midsubstance subcutaneous tears of the Achilles tendon by open suture, with immobilization in a cast with the ankle in gravity equinus for 2 weeks, followed by a front slab cast with the ankle in a plantigrade position, allowing weightbearing as able to full weightbearing, and ankle mobilization as the patients see fit, is as safe as a more traditional regimen of immobilization. It produces a high level of excellent subjective and objective results and can result in faster recovery and return to work and less use of rehabilitation resources. When compared with a group of similar patients operated on in the same setting by fully trained surgeons using a more traditional postoperative approach, these patients showed no adverse effects, and some variables showed better results. Although this regimen shortens the time needed for return to work and rehabilitation to sport, gastrosoleus muscle strength deficit and muscle atrophy are not prevented.

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