



## RESEARCH ARTICLE

## The “2-2-2” Early Mobilization Protocol in Achilles Tendon Rupture: A Pilot Case Series

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### Abstract

**Background:** Accelerated functional rehabilitation for acute Achilles tendon rupture has been supported by various studies, both as a stand-alone conservative treatment, as well as post-operative protocol. The following pilot case series questioned whether a simple home-based incremental intensity rehabilitation program involving early mobilization would allow for results similar to surgical treatment and other conservative treatment protocols upon comparison of re-rupture rates, residual pain, treatment satisfaction and quality of life acute rupture of the Achilles tendon.

**Methods:** Twelve patients were treated with the novel “2-2-2” rehabilitation protocol. Following a median follow-up period of sixteen months post acute Achilles tendon rupture, patients were clinically evaluated and completed a series of subjective patient-based questionnaires (FAAM, ATRS, LEFS, SF-12, VAS for pain and satisfaction towards treatment).

**Results:** No tendon re-ruptures were noted within this case series. Residual pain was low, while satisfaction towards the treatment was high, and all the collected scores compared favorably to the scores reported with surgery or other forms of conservative treatment.

**Conclusion:** Initial results for this pilot study suggest that the 2-2-2 rehabilitation protocol for acute Achilles tendon rupture deserves to be considered by the orthopedic community as a valid low-cost therapeutic option, and by the patients as a sound alternative to avoid surgery without compromising their recovery.

### Keywords

Achilles tendon rupture, Conservative treatment, Non-operative treatment, Early mobilization, Functional rehabilitation, Biologic approach

### Introduction

To this day, a consensus has yet to be reached within the orthopedic community for treatment of acute Achilles tendon rupture [1,2]. Defenders of the classical surgical tendon re-approximation approach argue superior benefits for young and active patients; lower re-rupture rates and a faster return to activities [3]. Recent evidence, however, suggests that a conservative approach, in the form of a well-structured rehabilitation program focused on intensive early mobilization, can achieve results that are comparable to surgical treatment, while also avoiding the risks of operative complications such as infection and soft-tissue related complications [1,4-6]. Nevertheless, conservative treatment protocols as currently reported in the literature pose a challenge to patients, physicians and physical therapists for being time-consuming, as well as having the potential for both poor compliance and loss to follow-up [6]. With these concerns in mind, we hypothesized that a simple home-based rehabilitation program respecting the early mobilization principle could help resolve this compliance issue while also achieving similar results to those reported for surgical treatment when comparing re-rupture rates, residual pain, satisfaction to treatment, and quality of life.

### Methods and Materials

A retrospective case series compiling consecutive cases of acute Achilles tendon rupture patients treated with the previously unreported “2-2-2” rehabilita-

tion protocol was conducted by the First Author (FL) between June 2011 and August 2014. Tendon ruptures were diagnosed clinically on the basis of a palpable gap and a positive Thompson test. Seven patients had, in addition, obtained diagnostic ultrasonography imaging prior to referral, two patients of which for whom clinical findings were ambiguous. Inclusion criteria for this case series included a confirmed diagnosis of acute Achilles tendon tear and willingness to undergo conservative treatment as part of the present study. Meanwhile, exclusion criteria included the presence of lacerations and/or chronic tears of the Achilles tendon, as well as patient inability to understand and/or follow a conservative treatment regimen.

Subsequent to diagnosis, patients were assigned an exercise regimen called the 2-2-2 protocol. The following protocol consists of three successive two-month periods of rehabilitation of incremental intensity. The first two-month period of rehabilitation consists in active non-weight-bearing resistance-free mobilization of the affected ankle. In the second two-month period of the protocol, patients progressively resume walking and begin (active/passive) resistance mobilization. Crutches are progressively weaned during this treatment phase. The third and last two-month period of rehabilitation consists in a gradual return to pre-injury activities. In addition, throughout the length of the 2-2-2 protocol, patients are instructed to use pain intensity and discomfort as indicators for when to interrupt ankle mobilization/activity and resume at a further time.

The 2-2-2 treatment protocol was designed into three phases of equal duration for the sake of simplicity, to ensure patient comprehension and ease compliance. Each phase is characterized by specific restrictions, while also allowing patients to incrementally make progress in terms of movement, strength, and function within safe limits determined by the protocol. The choice of establishing a two-month duration for each phase of the protocol is supported by the six-week observed timeframe, for soft tissue healing [7], to which an additional two weeks was added as a precautionary measure. The incremental weight-bearing increase over the time course

of the treatment was felt to be an important part of the protocol. Studies have shown that load application as well as controlled stretching within the six to ten weeks period of tendon healing would be associated with collagen fiber alignment improvement as well as strengthening [8-14].

Post-treatment assessment consisted of a physical exam, which included the Thompson test and ankle range of motion measurement. Patients were also asked to carry out one leg and two leg tip-of-toes stands, as well as one leg and two leg vertical leaps. Circumference measurements (cm) for both calves were taken at the largest girth using a measuring tape. Lastly, a series of questionnaires were answered by patients at the time of their follow-up visit, including the acute Achilles Tendon Rupture Score (ATRS) [15], the Foot and Ankle Ability Measure (FAAM) [16], the Lower Extremity Functional Score (LEFS) [17], the Twelve-Item Short Form Health Survey (SF-12) [18], and the Visual Analogue Scales (VAS) for pain and satisfaction to treatment.

Collection of patient data for this project was approved by the ethics board of our institution.

## Results

Eighteen patients with an acute Achilles tendon rupture were initially identified and presented with the option to follow the 2-2-2 rehabilitation protocol. Of those that were identified, four did not show up at the first follow-up visit, two assessed as successful recoveries decided not to participate in the study, leaving twelve subjects with a median 16 months post-injury follow-up (range 10-34 months) (Table 1). None of the twelve patients who followed the 2-2-2 protocol underwent surgical repair.

All patients presented with a positive Thompson test upon initial clinical assessment, with the exception of two for whom diagnosis was confirmed via ultrasound (17%). Of those two patients, one was diagnosed with a total Achilles tendon rupture, the other with an incomplete 70% tendon tear. All patients presented with negative Thompson tests by their last follow-up assessment. All patients were able to perform two leg tip-of-

**Table 1:** Study subject details.

Subject number	Age	M/F	Occupation	Injury
1	68	M	Retired federal government worker	Baseball
2	60	M	Science teacher	Walked in a hole
3	49	M	Graphic designer	Tennis
4	40	M	Web project manager	Soccer
5	48	M	Mechanic	Motocross accident
6	33	M	Sound technician	Badminton
7	34	M	Lawyer	Mogul skiing
8	41	M	Police officer	Badminton
9	52	M	Administrator	Soccer
10	45	F	Legal assistant	Fall from her height
11	39	M	Telecom worker	Soccer
12	47	M	Hotel baggage handler	Basketball

**Table 2:** Compiled scores of twelve subjects treated with the 2-2-2 protocol upon their last follow-up. FAAM-ADL and FAAM-SS: Foot and Ankle Ability Measure - Activities of Daily Living and Sports Subscales; ATRS: Achilles Tendon Rupture Score; LEFS: Lower Extremity Functional Scale; SF-12 PCS and SF-12 MCS: twelve-item Short Form health survey, Physical and Mental components; VAS: Visual Analog Scale.

	Median	Range
Follow-up (months)	16	10 - 34
FAAM- ADL	97	81 - 100
FAAM - SS	91	53 - 100
ATRS	93	42 - 99
LEFS	99	86 - 100
SF-12 PCS	52	35 - 61
SF-12 MCS	54	40 - 63
VAS - Pain	0.6	0.1 - 4.9
VAS - Satisfaction	9.7	2.7 - 10.0

toes stands. Eleven of the twelve patients were able to perform one leg tip-of-toes stands on the injured side. All patients were able to achieve a vertical leap with the injured leg.

Comparisons of calf circumferences for each patient revealed an average 2 cm smaller circumference for the injured side at follow-up (mean 37 vs. 39 cm,  $p = 0.002$  with the paired t-test).

Scores compiled for the different patient-based questionnaires are listed in (Table 2). The Visual Analogue Scale (VAS) for pain (0.6/10) and satisfaction to treatment (9.7/10) were both excellent.

Lastly, at this time, none of the patients included in this case series suffered a re-rupture of their injured Achilles tendon.

## Discussion

Overall results obtained for patients treated with the 2-2-2 protocol are promising with regards to re-rupture rates, residual pain, satisfaction to treatment and health-based quality of life. As such, the 2-2-2 protocol appears to be a safe and efficient conservative treatment alternative for acute Achilles tendon ruptures. The guiding principle for this rehabilitation protocol is early ankle motion, since it is believed to be the main reason why surgically treated Achilles tendon ruptures show a lesser rate of recurrence than those treated conservatively with a period of immobilization. This is supported by different studies showing an absence of difference in recurrence rate when comparing surgically treated ruptures to more aggressive conservative protocols which include early ankle motion [4-6].

Some of the main characteristics of the 2-2-2 protocol are to completely avoid immobilization while being simple enough to follow as a home-based rehabilitation. Furthermore, the 2-2-2 protocol can be achieved with no additional cost for the patient or the healthcare system.

Providing patients with specific activity limits for each treatment phase, while also asking them to use pain

intensity and discomfort as indicators for when to increase the range of motion and amount of weight-bearing for their injured ankle, seemed to be a low-cost, patient-centered way to achieve the goal of Achilles tendon rehabilitation.

In addition, while the choice of two-month interval appears to be supported by literature, it was however noted that many patients within this case series felt that they were ready for the next treatment phase before the end of their prescribed treatment interval. For this reason, shortening the length of each treatment phase may be considered in the future.

Patients included in this case series all displayed improved function by their last follow-up visit. Clinical healing of the ruptured tendon was observed for every patient. Scores for the Visual Analogue Scale (VAS) for residual pain were low (median 0.6 score on 10), whereas they were high in terms of treatment satisfaction (median score of 9.7 on 10). LEFS scores were also very high (median: 96; range: 86-100), indicating a relatively elevated function of the previously affected ankle.

The median ATRS score for patients at their last follow-up (91) was comparable to scores found in the literature for both surgical treatment and more aggressive conservative treatment protocols involving early ankle motion. In a recent study, Barfod, et al. [19] reported mean ATRS scores of 73 and 74 for early weight bearing and no weight bearing conservative treatment results respectively. Another study by Olsson, et al. [4] reported mean ATRS scores of 82 and 80 respectively, when comparing surgical vs. non-surgical management of acute rupture of Achilles tendon after twelve months of follow-up.

The FAAM scores obtained within this case series at the patients' last follow-up visit were similar to those obtained by Ahmad, et al. [20] in their study on non-surgical approach to ruptured myotendinous junction of the Achilles. Specifically, Ahmad, et al. reported FAAM-sports scores of 20.2% at presentation vs. 95.2% at follow-up, while the score observed at follow-up for patients treated with the 2-2-2 protocol was 90.6% for the FAAM-sports and 97.0% for activity of daily living (FAAM-ADL). It should however be noted that Ahmad, et al.'s average reported follow-up length was longer than the median follow-up for the 2-2-2 protocol (40 vs. 16 months).

A main advantage of the 2-2-2 rehabilitation protocol is that it is relatively easy for patients to understand and implement. Being a home-based rehabilitation program, it is accessible by virtue of not requiring patients with functional impairment to travel back and forth to the hospital or the physiotherapy clinic. Furthermore, overall results obtained in this study show that the majority of patients were highly satisfied with the treatment and its outcome.

To our knowledge, the 2-2-2 protocol is the first to allow immediate range of motion of the ankle without any immobilization in the process of healing. Avoiding immobilization and encouraging active range of motion allows a certain amount of beneficial stress and strain to the tendon, which is conducive to healing and strength recovery as suggested by studies on tendon healing [21-23]. However, a non-surgically treated healing tendon may be at risk for excessive stress if the patient immediately bears weight. Therefore, we recommend that patients not bear weight on the affected ankle for the first two months following injury, and instead actively move their ankle in dorsiflexion and plantar flexion to induce moderate tension in the healing tendon. A shorter weight-bearing avoidance period may be adequate, and this protocol modification would need to be investigated in the future.

Although it is to be expected of a study involving a small sample size of recruited patients, a notable limitation of this current pilot case series pertains to patient characteristics which may not represent the general population. Four of the eighteen initially selected patients were lost to follow-up following their initial visit, and although it is not possible to verify this, it can be hypothesized that some or all of these patients may have sought care elsewhere, and specifically elected for surgical treatment as opposed to the conservative course of treatment proposed to them by the First Author (FL). This is generally to be anticipated in the event of any novel treatment protocol diverging from what is considered the current standard of care. Another limitation is the absence of a control group in order to directly compare results between the 2-2-2 rehabilitation protocol and a surgical course of treatment and/or less other forms of conservative treatment. Future studies would compare different functional rehabilitation programs to the 2-2-2 protocol, while focusing on function, compliance, and cost-effectiveness. More importantly, a randomized controlled trial comparing surgical repair to other conservative rehabilitation programs such as the 2-2-2 protocol would allow a direct assessment of treatment efficacy, perhaps revealing that surgery may not be required to treat acute Achilles tendon rupture [1,4-6].

In conclusion, clinical results obtained as part of this pilot case series investigating the 2-2-2 protocol were deemed promising. No cases of re-rupture were observed among the 12 participating patients and overall treatment outcome and satisfaction were noted. Results appear to suggest that the 2-2-2 rehabilitation protocol is worthy of consideration by the orthopedic community as a valid low-cost, high satisfaction treatment option for acute Achilles tendon rupture, and also patients wishing to avoid surgery without compromising their recovery in the process.

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