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Original research

Do physical tests have a prognostic value in chronic midportion Achilles tendinopathy?☆

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ABSTRACT

Objectives: To determine whether baseline physical tests have a prognostic value on patient-reported outcomes in Achilles tendinopathy.
Design: Prospective cohort study, secondary analysis of data from a randomized trial.
Methods: Patients with chronic midportion Achilles tendinopathy performed a progressive calf muscle exercise program. At baseline and after 2, 6, 12 and 24 weeks, patients completed the Victorian Institute of Sports Assessment—Achilles questionnaire and performed the following physical tests: ankle dorsiflexion range of motion with a bent knee or an extended knee, calf muscle strength, jumping height and pain on palpation (Visual Analogue Scale; 0–100) and after 10 hops (Visual Analogue Scale-10-hops). Associations between baseline test results and improvement (Victorian Institute of Sports Assessment—Achilles scores) were determined using a Mixed Linear Model.
Results: 80 patients were included. The mean Victorian Institute of Sports Assessment—Achilles score improved 20 points (95 % confidence interval, 16–25, $P < .001$) after 24 weeks. There were significant associations between the baseline ankle dorsiflexion range of motion with a bent knee (β 0.2, 95 % confidence interval 0.001 to 0.3, $P = .049$), the baseline pain provocation tests (Visual Analogue Scale palpation: β −0.2; 95 % confidence interval: −0.4 to −0.1; $P < .001$, Visual Analogue Scale-10-hops: β −0.3; 95 % confidence interval: −0.4 to −0.2; $P < .001$) and the change in the Victorian Institute of Sports Assessment—Achilles score.
Conclusions: In patients with chronic midportion Achilles tendinopathy, easy-to-perform pain provocation tests have a clinically relevant prognostic value on patient-reported improvement. Patients with less pain during pain provocation tests at baseline have a better improvement in pain, function and activities after 24 weeks than patients with high baseline pain scores.

Practical implications

- Easy to perform pain provocation tests (10 hops and Achilles tendon palpation) before the start of a calf muscle training program can help to provide a prognosis of the course of AT.
- The level of pain during pain provocation tests for AT significantly decreased after 24 weeks.
- Measures of ankle dorsiflexion ROM and performance did change significantly after the 24 week follow-up, but the change was not clinically relevant.

1. Introduction

Achilles tendinopathy (AT) is a clinical diagnosis characterized by a combination of pain, swelling and impaired load-bearing capacity.[1] Patients are classified as having chronic AT when the symptom duration is more than 2–3 months.[2] It has a high incidence in primary health care with significant impact and substantial costs.[3,4] AT is best treated with a combination of education, load management advice and calf muscle exercise therapy, according to the latest clinical guideline.[2] Clinical tests are used for diagnosing and monitoring the treatment response in AT.[2,5] If simple clinical tests had a prognostic value this could help clinicians in providing more accurate expectations. The latest clinical guideline noted that there are no proven clinical tests that can be used to estimate the course of symptoms (prognosis).[2] Information about changes in the results of physical tests during treatment is also lacking.

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The primary aim of this study is to determine the prognostic value of the physical test results measured before initiating an exercise program of 24 weeks (baseline) on the change in the Victorian Institute of Sports Assessment—Achilles (VISA-A) score (difference between baseline and 24 week follow-up). The secondary aim was to report the changes in physical test results over time during treatment.

2. Methods

This prospective cohort study is a secondary analysis of the data of a recently published randomized controlled trial (RCT).[6] As there were no differences between the study arms in any of the predefined outcome measures, we considered both groups to be a single cohort for this current study. The study protocol (MEC 14-100) was approved by the local Medical Ethics Committee (Southwest Holland, the Netherlands). This RCT investigated the effect of a single high-volume injection in patients with chronic midportion AT in addition to a 24-week progressive calf muscle exercise program.[6] Patients received either 50 mL of 0.9 % sodium chloride solution (40 mL) with 1 % lidocaine (10 mL) or a placebo injection. The placebo contained the same mixture but only 2 mL was injected. After injection, outcome measures were obtained at 2, 6, 12 and 24 weeks. All patients were instructed by one blinded outcome assessor (A.V.) to perform a 24 week daily calf muscle exercise program, which consisted of 3 consecutive phases: isometric, isotonic and eccentric exercises. Each phase had a minimum duration of 1 week. If pain during exercises was acceptable (pain score ≤3/10 during activities of daily living), patients moved on to the next phase. The exercises were followed by a return to sports module, consisting of plyometric exercises followed by a gradual increase in running and interval training (if necessary for the type of sport).[6] After completing the program, patients were instructed to perform isotonic calf muscle maintenance exercises 3 times per week. The detailed protocol of the exercise program has been published before (https://www.bmj.com/content/bmj/suppl/2020/09/09/bmj.m3027.DC1/vlia054573.ww.pdf).[6]

The study was cooperatively designed at the Erasmus Medical Centre (Rotterdam, the Netherlands) and conducted at Haaglanden Medical Centre (Leidschendam, the Netherlands).[6] Patients were enrolled from December 2017 and the final visit of the last patient was in July 2019. We adhered to the STROBE guideline for reporting of cohort studies[7] and to the minimum reporting standards for tendinopathy studies according to the ICON consensus.[8]

Potentially eligible patients with pain in the Achilles region were assessed by a sports medicine physician. The main inclusion criteria were: (1) age 18–70 years, (2) tender and thickened Achilles tendon midportion, (3) symptom duration ≥ 2 months and (4) unsatisfactory outcome after ≥6 weeks of exercise therapy. In case of bilateral AT, the tendon with the highest symptom severity was injected and included in the study. In Appendix A a complete overview of inclusion and exclusion criteria is displayed. All participating patients provided written informed consent before inclusion.

The VISA-A is a self-administered questionnaire to assess the clinical severity of AT.[9] The VISA-A score ranges from 0 to 100 points, with a higher score representing less symptoms.[9,10] We administered the validated Dutch VISA-A questionnaire using an online form.[10] Patient-reported improvement was defined as a Minimal Clinically Important Difference (MCID) of 7 points on the VISA-A score.[11,12]

All physical tests were performed by one trained and blinded outcome assessor (A.V.) and done in the same order each time. As a warm-up, all participants had to walk up and down 4 flights of stairs. We distinguished 4 different types of physical tests: ankle dorsiflexion ROM, calf muscle strength tests, a performance test and pain provocation tests. In case of bilateral symptoms, tests were done on the most symptomatic side. The known intra-class correlation coefficients (ICCs) of each physical test are shown in Appendix F.

The weight-bearing dorsiflexion lunge test (WBDLT) was performed to measure ankle dorsiflexion ROM with a bent knee (Appendix B, 1A).[13] Ankle dorsiflexion ROM with an extended knee was measured with an extended-knee calf muscle stretch test (Appendix B, 1B).[14,15] Dorsiflexion ROM was measured using an inclinometer (Dr. Rippstein, Switzerland).

Soleus strength and gastrocnemius strength were measured on an examination table in a kneeling and prone lying position respectively (Appendix B, 1D and E). Strength was measured using a hand-held dynamometer (MicroFET2, Hoggan Health Industries, Salt Lake City, USA) attached to a fixation belt at the end of the table. The strength was expressed in newton and divided by the baseline body weight (kg). Each test was performed 3 times with a single leg and the highest outcome was used.

For the maximum single-leg jump test, the patient was instructed to jump as high as possible with a single leg (Appendix B, 1C). The jumping height was measured using a jump belt mat (Jump-MD, T.K.K.5106, Takei physical fitness jump test, Tokyo, Japan). Each test was performed 3 times and the highest jump was recorded as the outcome.

The severity of pain directly after the pain provocation tests was quantified with the Visual Analogue Score (VAS).[16] On this scale 0 represents 'no pain' and 100 represents 'the worst pain you can imagine'.[16] Palpation was performed in the Achilles midportion area. The blinded outcome assessor (A.V.) practiced performing a 1-kg pinch grip to apply the same amount of pressure each time. To determine the VAS after 10 hops (VAS-10-hops), the patient was asked to hop 10 times with a single leg and the VAS was recorded after performing this test.[17]

We used the Shapiro–Wilk test to assess the normality of the data. Normally distributed data were expressed as a mean with a standard deviation (SD). Non-normally distributed data were presented as a median with an interquartile range [IQR]. The change between the baseline and 24 week follow-up was assessed using a paired *t*-test (normally distributed data) or a Wilcoxon signed-rank test (non-normally distributed data). A Mixed Linear Model (MLM) was applied to determine the prognostic value of baseline physical tests on the change in VISA-A scores within the 24 week follow-up. The change in the VISA-A score was defined as the difference between the VISA-A score at baseline and after the 24 week follow-up. We adjusted for the baseline VISA-A score. We also adjusted for the following predefined variables if they influenced our regression coefficient Beta with ≥10 %: age, sex, body mass index (BMI), duration of symptoms at baseline, unilateral or bilateral AT and the level of sports activity measured with the ankle activity score (AAS).[17] The AAS is a validated and reliable tool to assess ankle-related physical activity in patients with ankle instability.[18] We used the AAS to adjust for ankle-related physical activity, which may largely influence the primary outcome (VISA-A score).[19] All variables were included as fixed effects in the model.

Associations were considered significant if $P \leq .05$. As this is a secondary analysis of a large RCT, we did not perform a sample size calculation for the research questions in this manuscript. As reported in the study protocol, a sensitivity analysis was performed if ≥5 % of the primary outcome (VISA-A score) was missing. SPSS software (V.24.0.0.1; SPSS, Chicago, Illinois, USA) was used for statistical analysis.

3. Results

A total of 80 patients consisting of 39 males (49 %) and 41 females (51 %) were included. The median [IQR] age of all patients was 50 [10] years. A complete overview of the baseline characteristics is displayed in Table 1. Appendix C shows the flow of patients through the study. One patient was lost to follow-up after 2 weeks. The other 79 patients completed the study for the predefined primary outcome measure (VISA-A score). At 24 weeks, 8 patients did not perform every physical test and 22 patients did not perform any physical test. Reasons for these missing data are presented in the legend of Appendix C. Since <5 % of the predefined primary outcome measure was missing, no sensitivity analysis was conducted.

Table 3 demonstrates the association between the baseline physical test results and the change in the VISA-A score (prognostic value).

Table 1
Demographic and baseline characteristics.

Population demographics (n = 80)	
Sex, n (%)	
Male	39 (49)
Female	41 (51)
Age, years, median [IQR]	50 [10]
Weight, kg, mean (SD)	83.7 (16.1)
Height, cm, mean (SD)	175.7 (10.1)
BMI, kg/m^2, median [IQR]	25.7 [6.1]
Waist circumference, cm, mean (SD)	94.6 (12.7)
AAS, median [IQR]	5 [1]
Tendinopathy descriptors (n = 80)	
Duration of symptoms, weeks, median [IQR]	63 [88]
General health participants (n = 80)	
Use of medication (painkillers), n (%)	5 (6)
Prior history of tendinopathy, n (%)	26 (32.5)

Abbreviations: n: number, SD: standard deviation, IQR: interquartile range, cm: centimeters, kg: kilogram, BMI: body mass index, kg/m^2: kilograms per square meter, and AAS: ankle activity score.

Table 3
Prognostic value of the baseline physical test results on the change in VISA-A score after 24 week follow-up.

Test	B	95 % CI	P
Ankle dorsiflexion ROM			
With a bent knee (°)	0.2[b]	0.001 to 0.3	.049[a]
With an extended knee (°)	0.2[c]	−0.2 to 0.6	0.39
Calf muscle strength tests			
Strength soleus per kg (N/kg)	2.4[b]	−0.3 to 5.1	0.08
Strength gastrocnemius per kg (N/kg)	1.0[b]	−1.8 to 3.8	0.48
Performance test			
Jumping height (cm)	0.1[b]	−0.03 to 0.5	0.11
Pain provocation tests			
VAS palpation	−0.2[b]	−0.4 to −0.1	<.001[a]
VAS after 10 hops	−0.3[d]	−0.4 to −0.2	<.001[a]

Abbreviations: 95 % CI: confidence interval, N/kg: newton per kilogram, cm: centimeters, VAS: Visual Analogue Scale, VISA-A score: Victorian Institute of Sports Assessment—Achilles score, BMI: body mass index, and AAS: ankle activity score (AAS).
[a] P ≤ .05.
[b] Adjusted for: BMI and AAS.
[c] Adjusted for: Age, sex, BMI, duration of symptoms at baseline, unilateral/bilateral AT, and AAS.
[d] Adjusted for: AAS.

There was a significant association between the baseline ankle dorsiflexion ROM with a bent knee and the change in the VISA-A score (β 0.15, 95 % CI 0.001 to 0.3). We adjusted for the variables BMI (19 %) and AAS (11 %). Associations were also found between the baseline pain provocation tests and the change in the VISA-A score. The associations of the VAS palpation (adjusted for BMI (14 %) and AAS (10 %)) and VAS-10-hops (adjusted for AAS (12 %)) were −0.24 (95 % CI: −0.4 to −0.1) and −0.28 (95 % CI, −0.4 to −0.2) respectively.

An overview of the mean VISA-A scores and the mean or median outcomes of each physical test at all timepoints is shown in Table 2. The unadjusted differences in VISA-A scores and physical test results between the baseline and 24 week follow-up are displayed in Appendix E.

4. Discussion

This is the first large prospective study in patients with chronic AT identifying responders to standard conservative treatment based on physical tests. We found a significant association between baseline ankle dorsiflexion ROM with a bent knee, VAS palpation and VAS-10-hops and the change in the VISA-A score. Knowledge of these associations is clinically relevant as they can assist healthcare providers to better estimate prognosis. This information can be shared with the individual and aid in the expectation management, which is part of patient education.[2] We discuss the clinical relevance of the physical tests in association with improvement below.

The results on the ankle dorsiflexion ROM tests are considered to be reliable since both measurement techniques (knee bent and knee extended) have intra-class correlation coefficients close to 1 (Appendix F). An inclinometer (Dr. Rippstein, Switzerland) is a frequently used, easily operated instrument in a clinical setting with a known measurement error of 6° for measuring ankle dorsiflexion ROM.[20,21] We demonstrated a significant association between the

Table 2
Outcome measurements of VISA-A scores and physical test results at follow-up.

	Baseline		2 weeks		6 weeks		12 weeks		24 weeks	
	n (%)	Mean (SD)/median [IQR], range*	n (%)	Mean (SD)/median [IQR]	n (%)	Mean (SD)/median [IQR]	n (%)	Mean (SD)/median [IQR]	n (%)	Mean (SD)/median [IQR]
VISA-A score	80 (100)	43 (15.7) 8–73	78 (97.5)	44 (14.6)	74 (92.5)	49 (17.5)	76 (95)	55 (19.5)	79 (99)	63[a] (22.6)
Ankle dorsiflexion ROM										
With a bent knee (°)	79 (99)	41.3 (7) 23–55	67 (84)	42.4 (7)	62 (78)	42.8 (8)	57 (71)	43.0 (7)	55 (69)	43.5[a] (7)
With an extended knee (°)	79 (99)	41.2 (7) 20–55	67 (84)	42.4 (7)	62 (78)	42.6 (6)	57 (71)	42.6 (7)	55 (69)	43.2[a] (6)
Calf muscle strength tests										
Strength soleus per kg (N/kg)	75 (94)	4.5 (1.2) 1.9–7.4	65 (81)	4.8 (1.0)	59 (74)	4.8 (1.0)	56 (70)	4.7 (1.0)	50 (63)	4.7 (1.1)
Strength gastrocnemius per kg (N/kg)	78 (98)	5.3 (1.3) 2.1–8.3	64 (80)	5.4 (1.2)	61 (76)	5.3 (1.0)	57 (71)	5.2 (1.2)	54 (66)	5.2 (1.5)
Performance test										
Jumping height (cm)	78 (98)	21.8 (6.7) 8–38	64 (80)	22.7 (6.5)	60 (75)	23.1 (6.6)	56 (70)	23.3 (6.6)	52 (65)	22.7[a] (6.3)
Pain provocation tests										
VAS palpation	80 (100)	61 [40–75] 2–100	73 (91)	59 [29–76]	65 (81)	47 [26–75]	59 (74)	40 [25–73]	57 (71)	29[a] [19-73]
VAS after 10 hops	80 (100)	42 [23–63] 0–100	73 (91)	38 [18–62]	63 (79)	26 [0–53]	60 (75)	24 [0–37]	53 (66)	6[a] [0-26]

Normally distributed data were expressed as a mean with a standard deviation (SD). Non-normally distributed data were presented as a median with an interquartile range [IQR]. When the unadjusted differences in VISA-A scores and physical tests results between baseline and 24 week follow-up were significant, this is shown in the table row with the results after 24 weeks.
Abbreviations: n: number, SD: standard deviation, IQR: interquartile range, VISA-A: Victorian Institute of Sports Assessment—Achilles score, N/kg: newton per kilogram, cm: centimeters, and VAS: Visual Analogue Score.
[a] P ≤ .05: difference between baseline and 24 weeks follow-up.
* range at baseline.

baseline ankle dorsiflexion ROM with a bent knee and the change in the VISA-A score. The Beta of the baseline test is 0.2. The value of 0.2 implicates that with every degree the baseline dorsiflexion ROM increases the VISA-A score increases with 0.2 points after 24 weeks. To give better insight into the clinical meaning we can compare a hypothetical group of patients with less dorsiflexion ROM at baseline to a group with more dorsiflexion ROM at baseline. The SD of the mean dorsiflexion ROM at baseline is 7. If we compare two groups of patients at the periphery of the SD, there is a difference of 14°. This means that the difference between the "low flexibility" group and a "more flexible" group in VISA-A scores after 24 weeks would only be 2.8 points. This small difference in the VISA-A makes it unlikely that the ankle dorsiflexion ROM with a bent knee at baseline has clinical utility to estimate which patients will achieve a clinically relevant change (minimum detectable change after 24 weeks is 7 points).[11,12]

We also found an association between the baseline pain provocation tests (VAS palpation and VAS-10-hops) and the change in VISA-A results. We illustrate the clinical relevance with another example. The Beta of the baseline VAS-10-hop is −0.3, which signifies that with every point the VAS score decreases at baseline, the VISA-A increases with 0.3 points after 24 weeks. In our study the IQR at baseline was 40 points. This means that patients with more pain after hopping at baseline (e.g. VAS score >70) have lower VISA-A scores after 24 weeks than those with less pain after hopping (e.g. VAS score <30). The difference between the two hypothetical groups would be around 12 points on the VISA-A score. The same interpretation can be applied with the Beta of the baseline VAS palpation of −0.2 and the corresponding IQR of 35. This difference is enough to be clinically relevant, since an individual improvement of 7 points on the VISA-A score is known to be a clinically relevant improvement.[11,12] The decrease of VAS scores after hopping that we found was similar to the results in several other studies in patients undergoing rehabilitation for AT.[22,23] This improvement is in line with the reduction of pain on physical activities following exercise therapy and rehabilitation.

In this study we found no association between baseline strength and changes in VISA-A results. We used a hand-held dynamometer to measure the strength. Our measurement technique was adapted from a previous reliability study, but its exact reliability and the accuracy are unknown.[24] There was also no association between the baseline jumping height and the change in the VISA-A score. This is in line with the finding that calf muscle strength is not associated with change in symptoms. This performance test could be seen as a measure of explosive strength and was not associated with the clinical outcome. Our study results (Table 2) on strength tests are similar to some previous studies. Two intervention studies using calf muscle strengthening exercises in patients with AT demonstrated a significant increase in calf muscle strength.[25,26] On the other hand, a large meta-analysis described only small strength increases in previous studies.[27] A factor to consider in this regard is that strength can be measured in different ways (e.g. maximum strength, reactive strength and explosive strength).[27] This might impact the results and conclusions. These findings stress the need for standardized, easy-to-perform strength tests. Jumping height increased significantly at the 24 week follow-up. There are conflicting results on the change of jumping height after exercise therapy. One RCT comparing calf muscle training with rest in 40 patients, found a significant difference in jumping height after 6 months in favor of the calf muscle exercise group.[23] On the other hand, another RCT with 38 patients, found no difference in jumping height after 6 weeks of calf muscle training.[22] This conflicting result might be explained by the short duration of exercise therapy in the second study.

A strength of this study was the robust study design with a relatively large sample of homogeneous patients. The questionnaire and almost all of the physical tests were proven to be reliable. The tests are easy to perform and do not require expensive equipment, making them generalizable for most clinical settings.

A study limitation was the missing data of some physical tests. These data are missing because patients were no longer invited for follow-up visits in the final half year of the original RCT, since the ultrasound machine was no longer available.[6] This machine was used to measure the degree of neovascularization as another secondary outcome. Based on this information, we assumed that the missing data of the physical tests were missing at random.

The researcher (A.V.) gained sufficient experience with the physical tests before starting the study. Formal reliability testing of the calf muscle strength tests was not feasible prior to the start of the study. On the other hand, other testing protocols have shown that hand-held dynamometry tests are reliable in general, especially when fixation bands are used.[24] Another study limitation is the fact that we did not perform a sample size calculation for these secondary analyses. We provided measures of dispersal in all analyses, to show estimates of the certainty of these findings. Our study found an association between pain-provoking tests and changes in the VISA-A score. It could be argued that this finding is a self-fulfilling prophecy. The VISA-A score also consists of pain scores during functional tasks and activity. We still think that these simple tests can aid in the clinical setting. Better estimation of prognosis could increase adherence and improve the relationship with the healthcare professional.[28]

Future research in this field is essential, as most questions about the prognosis of AT remain unanswered. We suggest further investigation of possible prognostic factors, such as change in the local Achilles tendon load or metabolic profile, that might help to predict the course of AT.[29] In addition, we recommend a prospective study with more advanced equipment to evaluate the prognostic value and the change in calf muscle strength. The reason for this is the limitation of unknown test characteristics for strength testing in the current study and the potential role of strength tests described in a recent systematic review.[27]

5. Conclusion

We found a clinically relevant association between higher baseline pain provocation test results (VAS palpation and VAS-10-hops) and worse clinical outcomes at follow-up. We also found that lower ankle dorsiflexion ROM with a bent knee was associated with worse clinical outcome, but the differences were small and within the possible measurement error meaning this is harder to use in practice. We suggest using pain provocation tests to help estimate the prognosis and monitor clinical improvement. This information can aid in expectation management as part of the patient education.

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Confirmation of ethical compliance

The study protocol was approved by the local Medical Ethics Committee (Southwest Holland, the Netherlands).

CRediT authorship contribution statement

Céline F.L. Mulder: Software, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Arco C. van der Vlist:** Conceptualization, Methodology, Investigation, Validation, Resources, Data curation, Writing – review & editing. **Marienke Van Middelkoop:** Software, Formal analysis, Data curation, Writing – review & editing. **Robert F. van Oosterom:** Investigation, Resources, Data curation, Writing – review & editing. **Peter L.J. van**

Veldhoven: Investigation, Resources, Data curation, Writing – review & editing. **Adam Weir:** Writing – review & editing. **Jan A.N. Verhaar:** Supervision. **Robert-Jan de Vos:** Conceptualization, Methodology, Investigation, Validation, Resources, Data curation, Writing – review & editing, Supervision, Project administration.

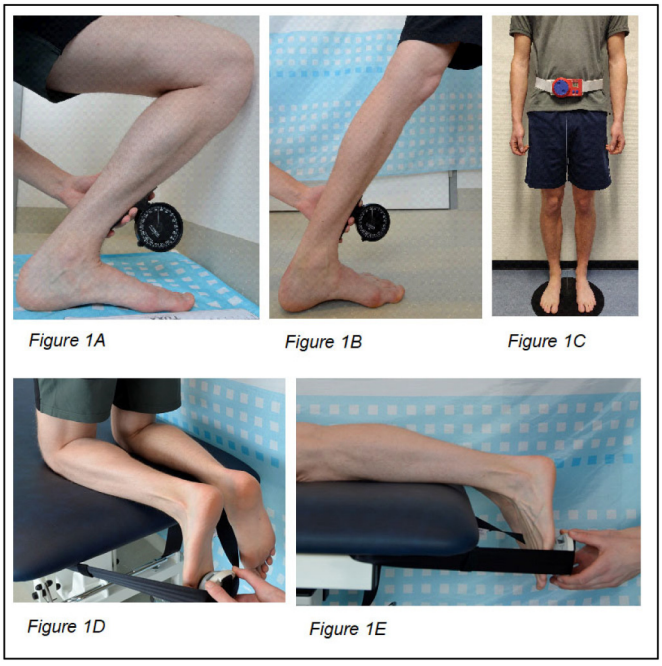
Declaration of interest statement

The authors certify that they have no affiliations with or financial involvement in any organization or entity with a direct financial interest in the subject matter or materials discussed in the article.

Appendix A. Overview of inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
- Painful swelling of the Achilles tendon 2–7 cm proximal to the insertion on the calcaneus - Symptoms for at least 2 months - Age 18–70 years - Unsatisfactory outcome after the performance of a 6-week exercise program - Presence of Doppler flow on ultrasonography examination	- Clinical suspicion of insertional disorders (pain at the site of the insertion of the Achilles tendon on the calcaneus) - Clinical suspicion of an Achilles tendon rupture (Thompson test abnormal and palpable "gap") - Clinical suspicion of plantar flexor tenosynovitis (posteromedial pain when the toes are plantar flexed against resistance) - Clinical suspicion of sural nerve pathology (sensitive disorder in the area of the sural nerve) - Clinical suspicion of peroneal subluxation (visible luxation of the peroneal tendon in combination with localized pain) - Suspicion of internal disorders: spondylarthropathy, gout, hyperlipidemia, rheumatoid arthritis and sarcoidosis - Condition that prevents the patients from executing an active exercise program - Recently prescribed drugs (within 2 years) with a putative effect on symptoms and tendon healing (quinolone antibiotics, corticosteroids) - Previous Achilles tendon rupture - Patient has received surgical intervention for his injury - Patient does not wish, for whatever reason, to undergo one of the two treatments - A medical condition that would affect safety of injection (e.g. peripheral vascular disease, use of anticoagulant medication) - Known presence of a pregnancy - Condition of the Achilles tendon caused by medications (arising in relation to moment of intake), such as quinolones and statins - Inability to give informed consent - Participation in other concomitant treatment programs - Patient has already one side included in this study - Allergy for lidocaine

Appendix B. Physical tests



1A. The patient stood near the wall and placed the (most) symptomatic foot in front of the least symptomatic foot. Then a forward lunge was performed until the patella touched the wall. The patient was asked to lunge as far as possible without lifting the heel of the (most) symptomatic foot off the ground and keeping the patella against the wall. Once maximal dorsiflexion was reached, an inclinometer was placed 15 cm below the tibial tuberosity to measure the ankle dorsiflexion ROM.

1B. The patient stood in front of the wall. The (most) symptomatic foot was placed behind the least symptomatic foot. Next, the patient was requested to lean forward as far as possible. The knee of the (most) symptomatic foot had to be kept in an extended position and the heel was not allowed to lift off the ground. The knee of the least symptomatic foot was allowed to slightly bent. When the patient reached maximum dorsiflexion, the angle was measured with an inclinometer placed 15 cm below the tibial tuberosity.

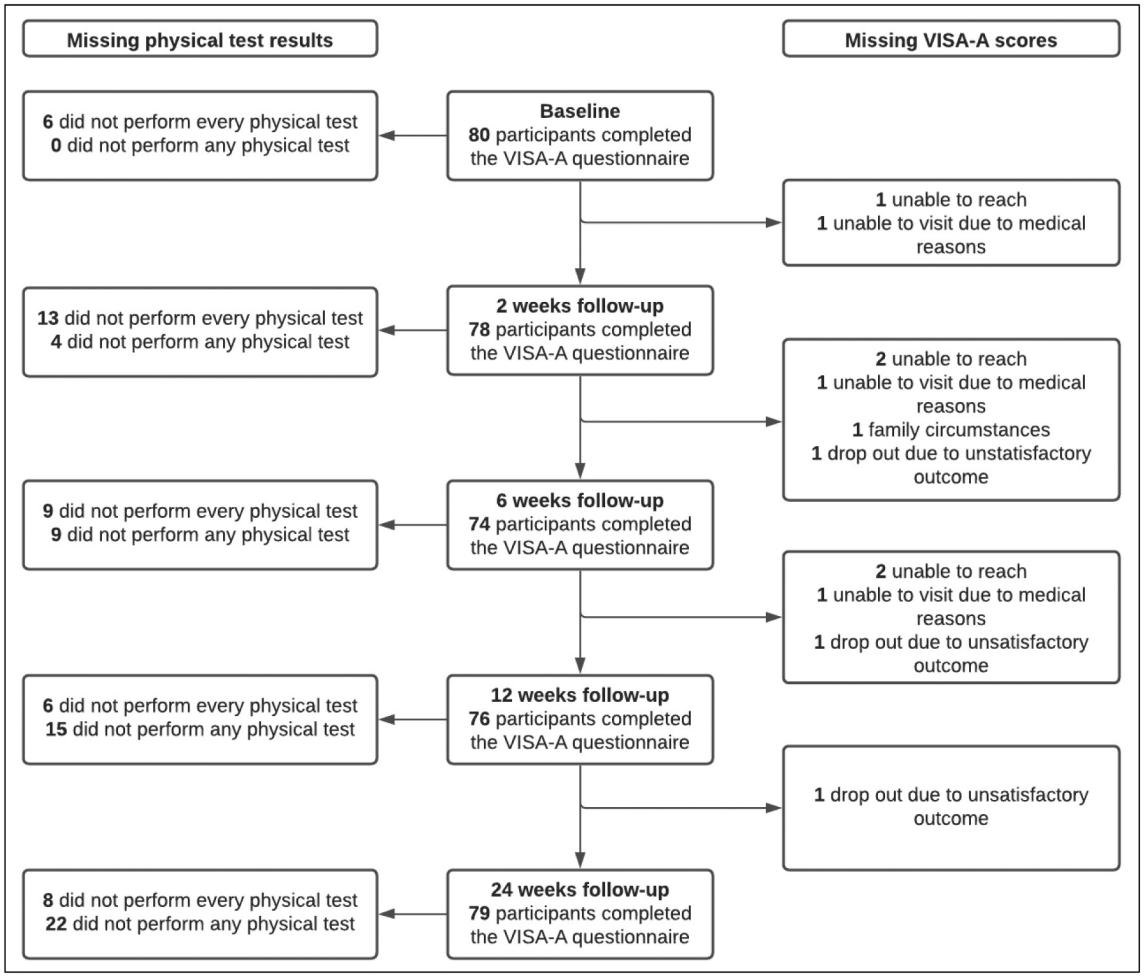
1C. The patient stood on the jump belt mat with the measurement device strapped around the waist. The measuring string was attached to the device and the jumping board. The patient was asked to stand up straight, while the measurement device was set at the starting point. Thereafter, the patient jumped as high as possible. No instruction on the jumping technique was given. The jumping height was shown on the screen of the measurement device.

1D. The strength of the soleus muscle was measured in a kneeling position on the research table with the feet hanging over the edge of the table. The hands of de patient were placed on the chest. The hand-held dynamometer, attached to the fixation belt, was placed on the ball of the (most) symptomatic foot. The patient was asked to push the dynamometer away as far as possible in 2 s, hold on for 5 s and then release tension in again 2 s.

1E. The strength of the gastrocnemius muscles was measured in prone lying position. The hands of the patient were lying alongside the body. The hand-held dynamometer, attached to the fixation belt, was placed on the ball of the (most) symptomatic foot. The patient was asked to push the dynamometer away as far as possible in 2 s, hold on for 5 s and then release tension in again 2 s.

Abbreviations: WBDLT: weight-bearing dorsiflexion lunge test.

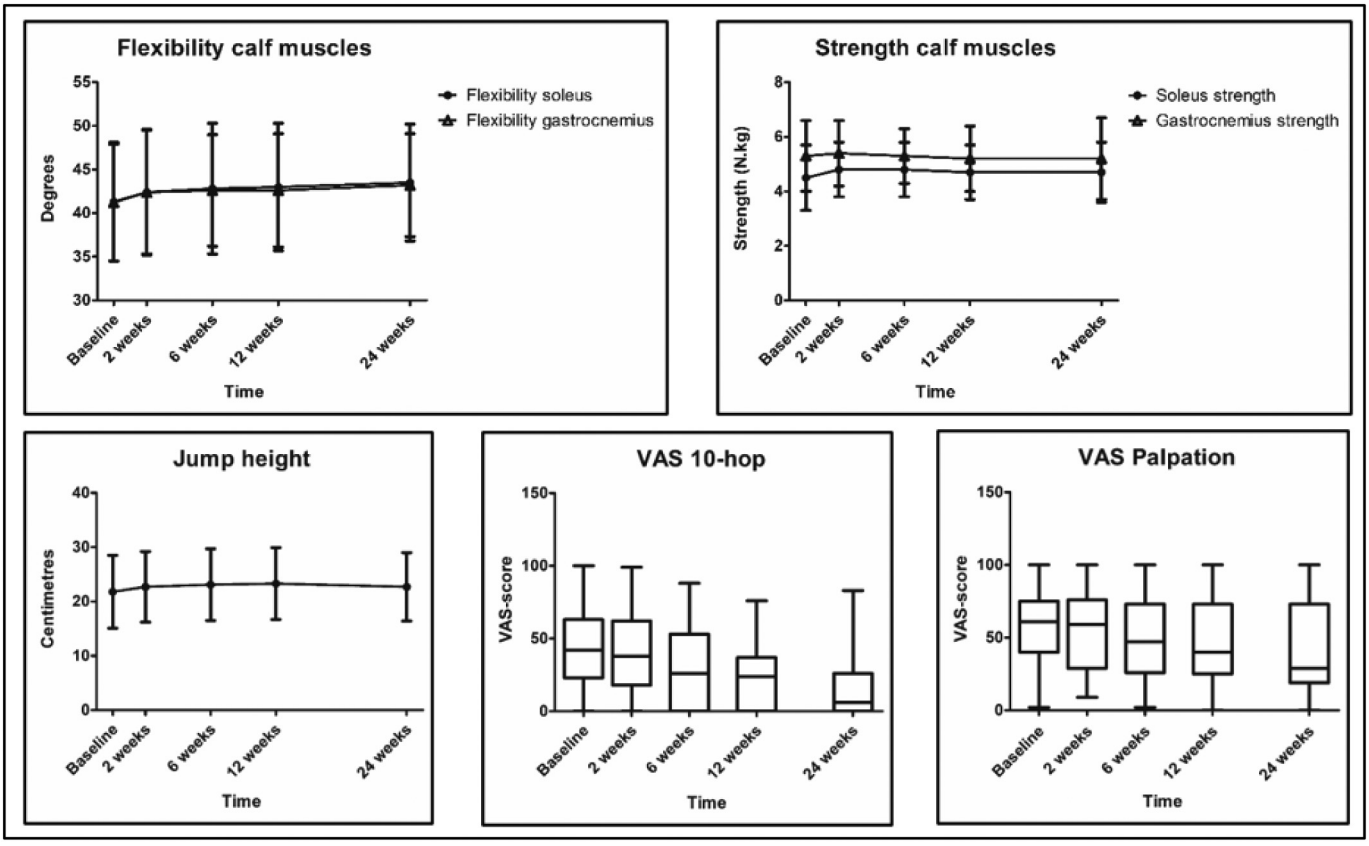
Appendix C. Flow diagram participants throughout follow-up



Abbreviations: VISA-A: Victorian Institute of Sports Assessment—Achilles, physical tests: ankle dorsiflexion ROM, calf muscle strength tests, performance test and pain provocation tests.

Reasons for missing data at the 24 week follow-up were: 1 (1 %) VISA-A questionnaire missing since 1 drop-out after 2 weeks due to unsatisfactory outcome, 22 (28 %) participants did not perform any physical test since they were no longer invited for follow-up visits as a result of the unavailable ultrasound machine, and 8 (10 %) participants did not perform every single physical test because of multiple reasons such as failing equipment, forgotten measurements or the fact that a person was not able to visit.

Appendix D. The course of physical test results through 24 weeks



Appendix E. Unadjusted differences in VISA-A scores and physical test results between baseline and 24 week follow-up

A paired *t*-test used for normally distributed data and a Wilcoxon signed-rank test used for non-normally distributed data

	n T0	T0, mean (SD) or median [IQR]	n T24	T24, mean (SD) or median [IQR]	Mean difference (95%CI) or Z-score	P-value
VISA-A score	79	42.6 (15.8)	79	62.8 (22.6)	20.2 (15.7 to 24.7)	<.001[a]
Ankle dorsiflexion ROM						
With a bent knee (°)	55	41.8 (7)	55	43.5 (7)	1.7 (0.8 to 2.5)	<.001[a]
With an extended knee (°)	55	42.0 (7)	55	43.2 (6)	1.2 (0.1 to 2.3)	.04[a]
Calf muscle strength tests						
Strength soleus per kg (N/kg)	48	4.6 (1.2)	48	4.7 (1.1)	0.1 (−0.2 to 0.3)	.48
Strength gastrocnemius per kg (N/kg)	53	5.4 (1.4)	53	5.2 (1.5)	−0.3 (−0.6 to 0.1)	.12
Performance test						
Jumping height (cm)	52	21.8 (6.4)	52	22.7 (6.3)	1.5 (0.4 to 2.5)	.01[a]
Pain provocation tests						
VAS palpation	80	61 [40–75]	57	29 [19–73]	−4.4	<.001[a]
VAS after 10 hops	80	42 [23–63]	53	6 [0–26]	−5.7	<.001[a]

Abbreviations: n: number, SD: standard deviation, IQR: interquartile range, 95 % CI: confidence interval, VISA-A score: Victorian Institute of Sports Assessment—Achilles score, N/kg: newton per kilogram, cm: centimeters, VAS: Visual Analogue Scale.

[a] P ≤ .05.

Appendix F. Reliability of the physical tests

Physical tests	ICC(reference)
Weight-bearing dorsiflexion lunge test	0.87–0.99[13,21]
Extended-knee calf muscle strength test	0.88[15]
Strength soleus test	Unknown
Strength gastrocnemius test	Unknown
Squat jump or counter-movement jump	0.91–0.98[23,30,31]
Pain during palpation	0.72[23]
Pain on hopping	0.83–0.94[31]

Abbreviations: ICC: intra-class correlation coefficient.

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