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Effectiveness of the Alfredson Protocol Compared With a Lower Repetition-Volume Protocol for Midportion Achilles Tendinopathy: A Randomized Controlled Trial

STUDY DESIGN: Randomized clinical trial.

OBJECTIVES: To compare the effectiveness of the Alfredson eccentric heel-drop protocol with a "do-as-tolerated" protocol for nonathletic individuals with midportion Achilles tendinopathy.

BACKGROUND: The Alfredson protocol recommends the completion of 180 eccentric heel drops a day. However, completing this large number of repetitions is time consuming and potentially uncomfortable. There is a need to investigate varying exercise dosages that minimize the discomfort yet retain the clinical benefits.

METHODS: Twenty-eight individuals from outpatient physiotherapy departments were randomized to either the standard (n = 15) or the do-as-tolerated (n = 13) 6-week intervention protocol. Apart from repetition volume, all other aspects of management were standardized between groups. Tendinopathy clinical severity was assessed with the Victorian Institute of Sport Assessment-Achilles (VISA-A) questionnaire. Pain intensity was assessed using a visual analog scale (VAS). Both were assessed at baseline, 3 weeks, and 6 weeks. Treatment satisfaction was assessed at week 6. Adverse effects were also monitored.

RESULTS: There was a statistically significant within-group improvement in VISA-A score for both groups (standard, $P = .03$; do as tolerated, $P<.001$) and VAS pain for the do-as-tolerated group ($P = .001$) at week 6, based on the intention-to-treat analysis. There was a statistically significant between-group difference in VISA-A scores at week 3, based on both the intention-to-treat ($P = .004$) and per-protocol analyses ($P = .007$), partly due to a within-group deterioration at week 3 in the standard group. There were no statistically significant between-group differences for VISA-A and VAS pain scores at week 6, the completion of the intervention. There was no significant association between satisfaction and treatment groups at week 6. No adverse effects were reported.

CONCLUSION: Performing a 6-week do-as-tolerated program of eccentric heel-drop exercises, compared to the recommended 180 repetitions per day, did not lead to lesser improvement for individuals with midportion Achilles tendinopathy, based on VISA-A and VAS scores.

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KEY WORDS: *eccentric exercise, pain, repetition volume, treatment satisfaction, VISA-A*

Tendinopathy is common in the sporting as well as the general population,[3,6] with pain and disability often persisting despite treatment.[2] Consequently, premature cessation of work or an athletic career often occurs, which results in a significant socioeconomic impact.[2,3]

The etiology of tendinopathy is still unclear; however, histological evidence consistently demonstrates an absence of prostaglandin-mediated inflammation.[4,11] Consequently, it has been recommended that the term *tendinopathy* replace the traditional term *tendinitis* for describing tendon pathology.[16] In addition, because inflammatory infiltrates are absent, it is recognized that anti-inflammatory strategies are generally ineffective for this condition. This shift in understanding of pathophysiology has prompted the use of interventions such as eccentric exercises to be considered as a viable option for rehabilitation.[2] Eccentric exercises are considered safe,[18] and previous work indicates success with this approach in the rehabilitation of midportion Achilles tendinopathies.[20,25,27,32]

The Alfredson protocol is a program of eccentric heel-drop exercises for treating Achilles tendinopathies. It has been widely adopted in research and clinical practice. The protocol recommends completion of 180 eccentric repetitions a day.[3] Currently, there is no strong rationale for this repetition volume.[39] The Alfredson protocol requires patients to continue with the exercise even if pain

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is experienced; however, the patient is advised to stop if the pain becomes disabling. This raises significant practical issues related to exercise adherence and treatment satisfaction, which may impact the overall treatment efficacy of the protocol. In addition, most of the previous research showing success with this approach has been conducted on athletic (or at least physically active) individuals.[31,35] In studies that have investigated the effectiveness of the eccentric exercises on a nonathletic population, the results have been less striking.[25,28] Therefore, the objective of this study was to compare the effectiveness of the Alfredson eccentric-exercise protocol with that of a modified protocol that allows participants to perform the exercises within their tolerance in both active and more sedentary individuals with midportion Achilles tendinopathy.

METHODS

Study Design

The present study was a prospective, outcomes assessor–blinded and statistician-blinded, randomized clinical trial evaluating participants over a period of 6 weeks. Participants were randomly allocated to 2 groups, both of which were taught the Alfredson eccentric-exercise protocol.[3] Those in the standard group were asked to perform 180 repetitions of the exercises per day, whereas those in the "do-as-tolerated" group were asked to perform the repetition amount they could reasonably achieve.

Participants and Recruitment

The protocol for this study was approved by the Research Ethics Committees of the United Kingdom National Health Service and of Queen Margaret University. Potential participants were identified on clinic waiting lists and were sent letters of invitation with details of the study. Potential participants were informed that they could withdraw from the study at any point and their care would not be affected by this decision. Participants provided informed consent and were examined as per normal assessment procedures. Safety and adverse effects were constantly monitored throughout the duration of the study by the treating clinicians.

Inclusion and Exclusion Criteria

The inclusion criteria were that the participants had to (1) be at least 18 years of age, (2) have symptoms lasting more than 3 months, and (3) have midportion Achilles tenderness (2-7 cm proximal to insertion) on palpation during or after activity. The exclusion criteria were (1) tendon insertion pain; (2) fracture of the affected lower limb within the last 12 months; (3) presence of bursitis, rheumatoid arthritis, diabetes, or other systemic disorders; (4) previous surgical intervention (within the last 12 months) or steroid injection (in the last month) near the Achilles tendon; (5) previous experience with eccentric-loading exercises; (6) sudden onset of symptoms suggesting partial rupture; and (7) any congenital deformity affecting the lower limb.

Procedures

Eight senior musculoskeletal physiotherapists collected data for this study. All data collectors and treating clinicians received standardized training concerning the study protocol, obtaining informed consent, assessment/diagnostic criteria, data recording, eccentric-exercise training protocol, and training progression. One of the authors (M.S.) provided all training. To minimize bias, the authors and the treating clinicians were not involved in data collection.

Eight clinical sites (2 district hospitals and 6 general practitioner practices) were utilized. Once the participant joined the study, baseline data using standardized protocols were obtained by the data collectors. Each participant was seen by the same treating clinician throughout the duration of the study. The treating clinician taught the participant the exercise technique and provided written instructions and a training diary for the participant to record the volume of exercise completed each day. At this stage, the treating clinician obtained the participant's group assignment by contacting the department secretary, who randomly selected a sealed, opaque envelope detailing the number of repetitions to be completed per day (standard versus do as tolerated). Participants were encouraged not to discuss their group assignment with anyone throughout the duration of their involvement in the trial, to ensure that the data collectors and authors were blinded to group allocation. Outcomes were re-evaluated 3 and 6 weeks later, at the participants' follow-up appointments. At week 3, correct exercise technique was ensured by the treating clinicians. At week 6, data on treatment satisfaction were also obtained.

Eccentric Exercise/Interventions

Both groups performed eccentric heel-drop exercises as described by Alfredson et al.[3] The standard group performed 180 repetitions a day, by completing 3 sets of 15 repetitions in 2 training positions (knee fully extended and knee slightly flexed) twice a day. The do-as-tolerated group also completed the eccentric heel-drop exercises in both training positions twice a day, with the recommendation that they achieve a repetition volume similar to that of the standard group, but they were also told that they could choose to complete a repetition volume that was tolerable. No further instructions were provided on the minimum or maximum repetition volume. Both groups were advised to exercise to discomfort but not excessive pain.[3] Participants were encouraged to progress training by wearing weighted backpacks if the exercise became less painful. They were also advised to avoid high-impact or sporting activities to allow relative rest until the pain subsided.

Outcome Measures

The Victorian Institute of Sport Assessment-Achilles The Victorian Institute of Sport Assessment-Achilles (VISA-A) was

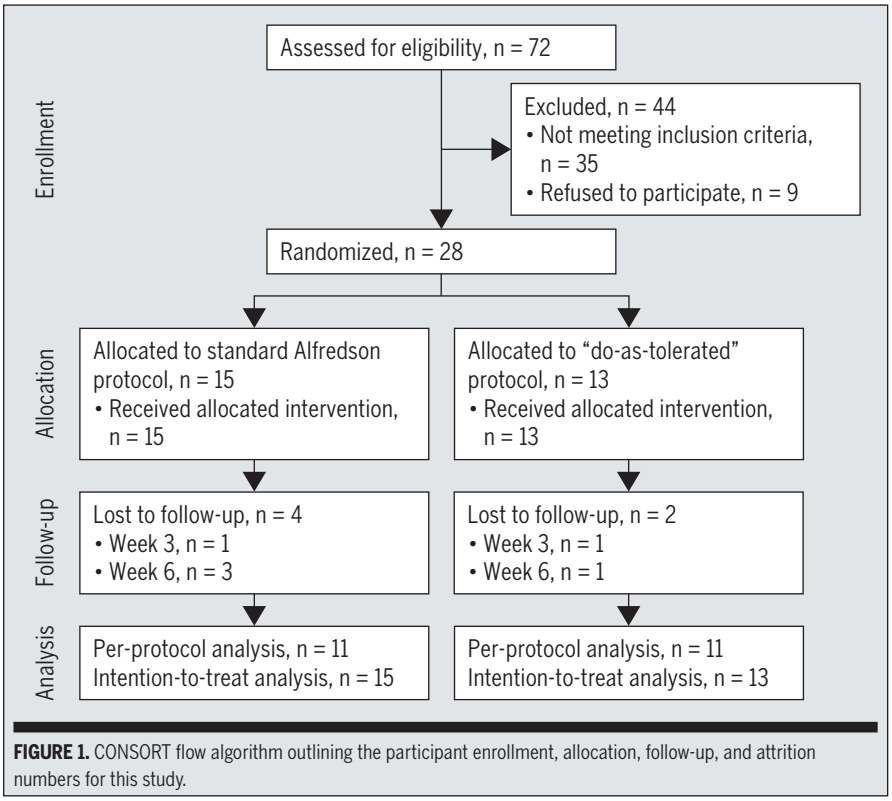

FIGURE 1. CONSORT flow algorithm outlining the participant enrollment, allocation, follow-up, and attrition numbers for this study.

chosen as the primary outcome measure for this study. This questionnaire consists of 8 questions assessing pain, function, and ability to participate in activity, with a score ranging from 0 to 100, higher scores indicating lower clinical severity of the condition. The VISA-A is deemed valid and reliable in individuals with Achilles tendinopathy[24] and is recommended for the assessment of Achilles tendinopathy.[7,14,33] For this study, a minimum clinically important difference (MCID) of 15 points was considered clinically significant, which is larger than that reported by Silbernagel et al.[30]

Visual Analog Scale for Pain A visual analog scale (VAS), on which 0 indicated no pain and 100 the worst pain imaginable, was used as a secondary measure of perceived pain intensity. The VAS is considered to be valid, reliable, and sensitive to change,[38] and has been used to evaluate tendinopathy-related pain.[2] For this study, an MCID of 15 points was considered clinically significant.[34]

Treatment Satisfaction Treatment satisfaction was also included as a secondary outcome measure. Participants were asked to rate their satisfaction with treatment as poor, moderate, good, or excellent.[9]

Sample-Size Determination

The VISA-A was the primary outcome measure for this study. A total of 30 participants were required to detect a clinically significant between-group difference of 15 points, assuming an estimated standard deviation of 14 points. Power and alpha level were set a priori at 80% and 5%, respectively. A VISA-A change score of 15 points was chosen based on clinical judgment, which is wider than the clinically significant difference of 10 points used in the study by Silbernagel et al.[30]

Statistical Analysis

Statistical analysis was conducted in a blinded manner, using an intention-to-treat (ITT) approach. A multiple-imputation approach, using SPSS Version 17 (SPSS Inc, Chicago, IL), was used to handle missing data. Data were missing in 21.4% of the participants, accounting for 6.7% of the total data. Little's test[19] showed that the data were missing completely at random ($\chi^2_{16} = 12.45$, $P = .071$). A per-protocol (PP) analysis was also performed and compared to the results of the ITT analysis to judge the extent to which the missing data might have influenced the results.

VISA-A and VAS pain data were analyzed separately using 2-by-3, 2-way, mixed-design analyses of variance. The between-subject factor was the repetition volume performed (standard versus do as tolerated), and the within-subject factor was the assessment time (baseline, week 3, and week 6). The chi-square test with the Yates correction test was used to analyze the association between participants' treatment satisfaction and their allocated treatment groups. The differences in mean number of exercise repetitions per day performed by the groups were analyzed using the Mann-Whitney test. Appropriate post hoc analysis was used to analyze differences.

Correlational analysis was performed to determine the relationships between (*a*) the activity levels of participants (active or sedentary) and mean exercise repetition volume performed per day, and (*b*) the participants' treatment satisfaction ratings with changes in VISA-A and VAS pain scores.

RESULTS

Participants

Seventy-two individuals were identified, of whom 28 (11 men, 17 women) were recruited and randomly allocated to the treatment groups. Trial recruitment and retention data are provided in **FIGURE 1**. Forty-four potential participants were not included in the study for the following reasons: declined participation in the study (n = 9), diagnosis of insertional tendinopathies (n = 19), inability to perform or previous experience with eccentric exercises for

TABLE 1 Baseline Demographics and Clinical Characteristics of Participants (n = 28)*

	Standard Volume (n = 15)	Do as Tolerated (n = 13)
Age, y	48.2 ± 10.8	49.2 ± 11.3
Body weight, kg	88.3 ± 14.0	84.5 ± 14.6
Height, m	1.68 ± 0.13	1.75 ± 0.10
Body mass index, kg/m^2	31.6 ± 6.1	29.5 ± 5.3
Duration of symptoms, mo	6.2 ± 2.1	8.9 ± 5.1
Men/women, n	6/9	5/8
Active†/sedentary, n	6/9	7/6

**Values are mean ± SD except for gender and activity level.*
†Defined as participating in recreational or competitive activities that loaded the lower limb more than 4 times a week for more than 30 minutes at a time.

Achilles tendinopathies (n = 7), equivocal diagnoses (n = 2), complete tendon rupture (n = 1), suspected rheumatoid arthritis (n = 3), and ankle fracture within the last 12 months (n = 3). Twenty-six (93%) participants provided data at week 3, and 22 participants (79%) at week 6. Therefore, 6 (21%) participants were lost to follow-up. **TABLE 1** provides the participants' characteristics for the 2 treatment groups.

Repetition Volume

The mean numbers of repetitions completed per day by the participants were 112 (95% confidence interval [CI]: 85, 139) and 166 (95% CI: 150, 182) for the do-as-tolerated and standard groups, respectively. There was a significant difference between the volumes of eccentric exercise completed for each group (U = 31.0, P = .001). The level of association between the exercise repetition volume and the activity level of participants (active or sedentary) was not significant (r_{pb} = 0.21, P = .37).

VISA-A Scores

Both groups improved in perceived clinical severity over the 6-week intervention program (**TABLES 2** and **3**). The do-as-tolerated group, using the ITT analysis, demonstrated a nearly linear improvement over time, with a mean VISA-A score of 47.1 at baseline improving to 62.5 at week 6, which resulted in a statistically significant mean difference of 15.4 points (95% CI: 9.8, 21.1). Data for the PP analysis were similar, with 49.9 at baseline, 63.2 at 6 weeks, and a change of 13.3 points (95% CI: 7.7, 18.8). For the standard-protocol group, perceived clinical severity initially deteriorated, then, by week 6, improved above its baseline value. In this group, using the ITT analysis data, the baseline VISA-A score was 49.6 (49.2 for PP analysis) and eventually improved to 58.7 (57.4 for PP analysis), resulting in a statistically significant mean difference of 9.1 points (95% CI: 0.9, 17.4; P = .03) with the ITT analysis and 8.2 points (95% CI: −1.4, 17.8; P = .09) with the PP analysis.

The between-group difference in VISA-A change scores was not statistically significant at week 6 (ITT, P = .20; PP, P = .32) (**TABLES 2** and **3**). But there was a statistically significant difference in VISA-A change scores between groups at week 3 (ITT, P = .004; PP, P = .007), which may be partially attributed to the worsening in VISA-A score for the standard group at that time.

The results of the ITT (**TABLE 2**) and PP (**TABLE 3**) analyses for VISA-A data were compared to examine the influence of missing data on the results. For the standard-protocol group, the 95% CI for the within-group change scores from baseline to 6 weeks was slightly narrower with the ITT analysis (0.9, 17.4) compared to the PP analysis (−1.4, 17.8). Likewise, the 95% CI for the within-group change score at week 3 for the do-as-tolerated group was slightly narrower with the ITT analysis (0.1, 18.2) compared to the PP analysis (−1.8, 20.2).

This resulted in the within-group change score at week 6 for the standard-protocol group being statistically significant with the ITT analysis but not with the PP analysis. The results for the between-group comparisons were similar when using either the ITT or PP analysis, with a significant difference between groups present at week 3 but not at week 6.

VAS Pain Scores

For the standard-protocol group, based on the ITT analysis, the mean VAS pain score improved from a baseline of 52.2 mm to 40.4 mm (from 58.2 mm to 42.1 mm with the PP analysis). For the same time period, the do-as-tolerated group improved from 55.4 mm to 31.5 mm (from 53.6 mm to 34.7 mm with the PP analysis). The between-group difference for VAS pain change score from baseline was not statistically significant at week 3 (ITT, P = .23; PP, P = .61) and at week 6 (ITT, P = .14; PP, P = .73) (**TABLES 2** and **3**).

The overall results with the ITT (**TABLE 2**) and PP (**TABLE 3**) analyses for VAS pain were similar to the results for the VISA-A scores. The within-group VAS pain change score for the standard group at week 6 had a slightly narrower 95% CI with the ITT analysis (−24.0, 0.2) compared to the PP analysis (−30.2, −2.0). This did not have an impact on the results. The standard-group VAS pain within-group change score at week 6 with the PP analysis returned a statistically significant result compared to that of the ITT analysis.

Treatment Satisfaction

FIGURE 2 shows the satisfaction rating of participants at week 6. Five participants (38.4%) in the do-as-tolerated group and 4 participants (26.7%) in the standard group reported their satisfaction as excellent. No participants in either group reported poor satisfaction with

TABLE 2 Outcome Measures at Baseline, Week 3, and Week 6 for Participants in the Standard (n = 15) and Do-as-Tolerated (n = 13) Groups (Intention-to-Treat Analysis)

	Baseline	Week 3	*P* Value (Effect Size)	Week 6	*P* Value (Effect Size)
Outcome measures*					
VISA-A					
Standard	49.6 ± 10.2	41.0 ± 13.0		58.7 ± 13.0	
Do as tolerated	47.1 ± 15.6	56.2 ± 19.7		62.5 ± 12.8	
Pain VAS, mm					
Standard	52.2 ± 15.0	51.3 ± 18.4		40.4 ± 17.9	
Do as tolerated	55.4 ± 18.4	46.6 ± 23.6		31.5 ± 18.7	
Within-group change score from baseline†					
VISA-A					
Standard		−8.6 ± 14.4 (−16.6, −0.6)	*P* = .04	9.1 ± 14.9 (0.9, 17.4)	*P* = .03
Do as tolerated		9.1 ± 14.9 (0.1, 18.2)	*P* = .05	15.4 ± 9.3 (9.8, 21.1)	*P*<.001
Pain VAS, mm					
Standard		−0.9 ± 17.4 (−10.6, 8.7)	*P* = .83	−11.9 ± 21.9 (−24.0, 0.2)	*P* = .05
Do as tolerated		−8.7 ± 15.4 (−18.1, 0.6)	*P* = .06	−23.9 ± 19.2 (−35.5, −12.3)	*P* = .001
Between-group difference in change score‡					
VISA-A		17.7 (6.2, 29.1)	*P* = .004 (1.23)	6.3 (−3.6, 16.1)	*P* = .20 (0.42)
Pain VAS, mm		−7.8 (−20.7, 5.1)	*P* = .23 (0.45)	−12.0 (−28.1, 4.1)	*P* = .14 (0.55)

Abbreviations: VAS, visual analog scale; VISA-A, Victorian Institute of Sport Assessment-Achilles.
**Values are mean ± SD.*
†Values are mean ± SD (95% confidence interval), except where indicated otherwise.
‡Values are mean (95% confidence interval), except where indicated otherwise.

the treatment received. Treatment satisfaction was not associated with type of treatment received at week 6 ($\chi^2 = 0.50$, $P = .92$). There was no significant correlation between the participants' treatment satisfaction ratings and the changes in VISA-A and VAS pain scores ($\tau = 0.28$, $P = .09$ and $\tau = -0.27$, $P = .10$, respectively).

DISCUSSION

There was no statistically significant difference in change scores between the standard group and the do-as-tolerated group for VISA-A and VAS pain scores at the conclusion of the 6-week intervention, based on both the ITT and PP analyses. However, there was a statistically significant between-group difference in VISA-A scores at week 3 with both the ITT and PP analyses. This was partially attributed to the worsening VISA-A scores at week 3 for the group training using the standard protocol. For both groups, the ITT analysis indicated a statistically significant within-group improvement in VISA-A and VAS pain scores after the 6-week intervention. Similar results were found with the PP analysis, with the exception that the within-group improvement in VISA-A score for the standard training protocol group was no longer significant.

VISA-A and Pain Scores

Within-Group Results Both groups in our study had within-group VISA-A and VAS pain change scores at week 6 that were similar to those previously reported in the literature on the Alfredson protocol.[12,20,25,28,31] Most similar to the results of our study was the 11.5-point VISA-A improvement after a 12-week eccentric-exercise program, previously reported by Sayana and Maffulli.[28] Rompe et al[25] reported a slightly larger change in VISA-A (25.0 points) after a 16-week program, whereas Herrington and McCulloch[12] found VISA-A improvements of approximately 19.0, 31.0, and 36.0 points from baseline at weeks 4, 8, and 12, respectively.

Similar improvements in pain intensity over time were also reported by previous authors. Silbernagel et al[31] reported a median improvement from baseline on the VAS of 9, 14, and 28 mm at 6, 9, and 12 weeks, respectively. Mafi et al[20] found a VAS pain score improvement of 57 mm after a 12-week program, but only in participants who were satisfied with treatment.

It is important to note that our study did not follow the participants after the 6-week program. The total exercise volume would be much higher over a longer period (eg, 1-5 years) and may be associated with clinical improvements.[29,35] It would be of interest for future research to investigate the long-term influence of repetition volume on clinical progress.

Between-Group Results In the present study, with both ITT and PP analyses there was a statistically significant between-group difference in VISA-A

TABLE 3 Outcome Measures at Baseline, Week 3, and Week 6 for Participants in the Standard (n = 11) and Do-as-Tolerated (n = 11) Groups (Per-Protocol Analysis)

	Baseline	Week 3	*P* Value (Effect Size)	Week 6	*P* Value (Effect Size)
Outcome measures*					
VISA-A					
Standard	49.2 ± 10.4	39.2 ± 11.0		57.4 ± 12.4	
Do as tolerated	49.9 ± 14.2	59.1 ± 18.9		63.2 ± 11.8	
Pain VAS, mm					
Standard	58.2 ± 12.0	53.8 ± 20.4		42.1 ± 17.9	
Do as tolerated	53.6 ± 16.8	45.6 ± 22.8		34.7 ± 16.5	
Within-group change score from baseline†					
VISA-A					
Standard		−10.0 ± 13.5 (−19.1, −0.9)	*P* = .03	8.2 ± 14.3 (−1.4, 17.8)	*P* = .09
Do as tolerated		9.2 ± 16.3 (−1.8, 20.2)	*P* = .09	13.3 ± 8.3 (7.7, 18.8)	*P*<.001
Pain VAS, mm					
Standard		−4.4 ± 16.4 (−15.4, 6.6)	*P* = .40	−16.1 ± 21.0 (−30.2, −2.0)	*P* = .03
Do as tolerated		−8.0 ± 16.8 (−19.3, 3.3)	*P* = .14	−18.9 ± 16.1 (−29.8, −8.1)	*P* = .003
Between-group difference in change score‡					
VISA-A		19.2 (5.8, 32.5)	*P* = .007 (1.42)	5.1 (−5.3, 15.5)	*P* = .32 (0.36)
Pain VAS, mm		−3.6 (−18.4, 11.1)	*P* = .61 (0.21)	−2.8 (−19.5, 13.9)	*P* = .73 (0.13)

Abbreviations: VAS, visual analog scale; VISA-A, Victorian Institute of Sport Assessment-Achilles.
**Values are mean ± SD.*
†Values are mean ± SD (95% confidence interval), except where indicated otherwise.
‡Values are mean (95% confidence interval), except where indicated otherwise.

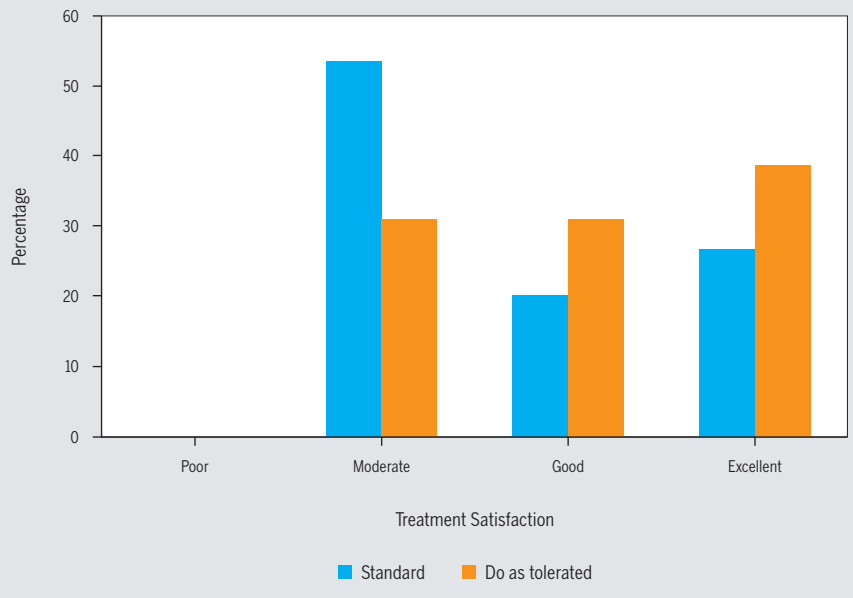

FIGURE 2. Treatment satisfaction for the eccentric-exercise program at week 6 for the Alfredson protocol (standard group) and the "do-as-tolerated" group. There was no significant association between reported treatment satisfaction and allocated treatment group.

scores at week 3. This difference was also clinically significant, based on an MCID of 15 points for the VISA-A. This difference was attributed to a statistically significant worsening of VISA-A score in the standard group, combined with a moderate but non–statistically significant improvement in VISA-A score in the do-as-tolerated group. This finding may have implications for eccentric-exercise prescription dosage, suggesting that the do-as-tolerated approach may prevent this initial worsening of the condition.

In contrast, similar studies with follow-up periods of 2 to 4 weeks have observed a general improvement in VISA-A and Knee injury and Osteoarthritis Outcome Score for patients undergoing eccentric-loading exercises.[12,22] In another study, there was only a slight, non–statistically significant worsening in functional index of the leg and lower limb scores.[8] Therefore, further investigation of the short-term impact of adhering to a protocol of 180 repetitions a day may be warranted to verify our findings. This is also important for clinicians looking for a less demanding but equally effective alternative protocol to the 180-repetitions-per-day protocol.

Furthermore, looking at the 95% CIs for the VISA-A between-group change scores at 6 weeks, the lower limits are −3.6 points (ITT analysis) and −5.3 points (PP analysis). As these values are much smaller than the 15-point MCID for the VISA-A, the do-as-tolerated regimen may not be inferior to the standard protocol. In contrast, the 95% CI upper limits for the between-group VISA-A change scores are 16.1 points with the ITT analysis and 15.5 points with the PP analysis, leaving open the possibility of a clinically meaningful benefit of the do-as-tolerated regimen over the standard regimen (ie, an MCID for the VISA-A of greater than 15 points may be present).

For the pain VAS scores, there were no statistically or clinically significant between-group differences at either week 3 or week 6. A close look at the 95% CIs of these differences reveals that the upper limits, indicating less pain reduction for the do-as-tolerated regimen compared to the standard regimen, have an MCID of less than 15 mm, providing confidence that the do-as-tolerated regimen is not less effective than the standard regimen. In contrast, the lower limits of the 95% CIs, which are greater than the 15-mm MCID for pain, leave open the possibility of a clinically significant greater benefit of the do-as-tolerated regimen.

Eccentric-Exercise Load

Based on our results, defining the optimal dosage (duration, frequency, and intensity) of eccentric exercises is necessary to rehabilitation for tendinopathy. From the perspective of individualized rehabilitation, an appropriate clinical predictor for guiding exercise dosage may be helpful. This potential clinical predictor could simply be based on the aggravation of symptoms or a heuristic process used by patients who have shown optimal clinical improvements. For example, Silbernagel et al[29] used a pain-monitoring model to help with exercise adherence and to prevent overloading and underloading of the tissue. Such a strategy may allow patients to take a more active role in the management of their condition. One potential benefit of active patient management is improved self-efficacy, which has been linked to positive outcomes for treatment of musculoskeletal conditions.[21]

An often-mentioned threshold for good adherence to an eccentric-exercise regimen is above 75% of the total desired exercise volume (eg, 135 of 180 repetitions).[10,26,28] In our study, the standard-regimen group achieved a mean exercise volume that was above this threshold. In contrast, the exercise volumes for the do-as-tolerated group fell below this threshold. If the do-as-tolerated group is generalizable to patients displaying moderate adherence to exercise programs, this implies that these patients could potentially still benefit from a modified Alfredson protocol.

Limitations

Though the clinical diagnosis of midportion Achilles tendinopathy in this study was made by experienced clinicians, it can be argued that diagnostic imaging, ultrasound, or magnetic resonance imaging[15] should have been considered to confirm the diagnosis. Although both imaging techniques can locate lesions, they cannot differentiate between tendinosis and partial rupture.[5] Also, pathological findings correlate poorly with patient symptoms.[23] Khan et al[17] suggested that imaging may offer little additional information to experienced clinicians.

Previous studies have included performance-related outcome measures such as the countermovement jump, drop countermovement jump, hopping, eccentric/concentric toe raise, and standing toe raise test.[30] The rationale for these performance-related outcomes is the assessment of the tissue-remodeling aspect of eccentric exercises through mechanically loading the musculotendinous structure.[30] Future studies should consider adding these types of outcome measures.

While the VISA-A may be considered a condition-specific measure, it might have been beneficial to include a more generic outcome measure to capture more functional aspects of outcomes. One potential valid, reliable, and responsive generic questionnaire for lower-limb conditions is the Lower Extremity Functional Scale,[6] which has shown good psychometric properties in single-condition studies.[1,13,37] However, there are currently no studies examining the psychometric properties of the Lower Extremity Functional Scale for Achilles tendinopathy.

While all data collectors received standardized training on the study protocol, the interrater and intrarater reliability of the data collectors was not determined. A future refinement of this study would either introduce reliability testing or reduce the number of data collectors. The numerous data collectors in the present study were the result of a pragmatic decision to use 1 data collector at each of the clinical sites.

CONCLUSION

At the completion of a 6-week heel-drop eccentric-exercise program, there were no statistically significant differences in VISA-A and pain VAS change scores between a group of patients with midportion Achilles tendinopathy who performed 180 repetitions of the exercise per day and a group that was instructed to do the number of repetitions based on tolerability. Both groups showed statistically and clinically significant improvement in pain and VISA-A scores after 6 weeks. However, there was a statistically significant deterioration of VISA-A scores observed for those performing 180 repetitions daily at week 3. Further research is required to determine the optimal parameters of eccentric exercise in the management of midportion Achilles tendinopathy. ◉

KEY POINTS

FINDINGS: There was no difference in VISA-A and pain change scores between 2 groups of patients with midportion Achilles tendinopathy who performed heel-drop eccentric exercises (180 repetitions daily compared to do as toler-

ated). Both groups showed clinically and statistically significant improvement at the end of the 6-week intervention.

IMPLICATIONS: As opposed to using a fixed number of repetitions, patient tolerance of the exercise may need to be considered when determining proper dosage for a program of eccentric heel-drop exercises to address midportion Achilles tendinopathy.

CAUTION: The study included a limited number of participants, and there was no follow-up beyond the 6 weeks of the study. Future research needs to systematically investigate what the proper dosage of exercise is for this condition.

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