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Title

Extra-Corporeal Shockwave Therapy (ESWT) plus rehabilitation for insertional and non-insertional Achilles Tendinopathy shows good results across a range of domains of function

Abstract

Achilles tendinopathy, both insertional and non-insertional, are common cause of posterior ankle pain. Whilst many patients will improve with simple conservative measures, a proportion will go on to chronic symptoms. This study examines the outcomes of patients following Extra-Corporeal Shockwave Therapy (ESWT) plus a home exercise programme. This prospective case series study involves a total of 39 patients with a mean follow-up duration of 163 days (range 65 – 385 days.) This has demonstrated significant benefits in pain, stiffness, and a range of measures of local and global function. Median (IQR) values for average self-reported pain improved from 6.5/10 (IQR: 5.0 - 7.8) at baseline to 3.5/10 (2.0 - 5.1) at three-months and 2.0/10 (0.6 - 4.8) at six-months for patients with insertional Achilles tendinopathy. This compares to improvements from 7.0/10 (7.0 – 8.0) at baseline to 6.0/10 (5.6-6.8) at three-months and 6.0/10 (3.0-7.0) at six-months for patients with non-insertional Achilles tendinopathy. Statistically significant improvements were seen in insertional tendinopathy across a range of outcome measures, although these were less apparent for patients with non-insertional tendinopathy. Despite these figures, there were no significant differences seen in the outcomes for patients with insertional and non-insertional tendinopathy. Despite the improvements that were seen in aspects of pain and function, physical activity levels had not increased following treatment.

Level of Clinical Evidence: 4

Key words: Achilles tendon, high-energy shock waves, patient outcome assessment, tendinopathy, treatment

Introduction

Rather than a single clinical entity, two distinct anatomical locations of Achilles tendinopathy are described. The commoner site is in the mid-portion of the Achilles tendon with maximal pain and swelling occurring between 2 and 7 cm proximal to the calcaneal attachment.(1) This is a relatively common condition, with an incidence in primary care of 2.35/1000 adults.(2) A less common type affects the insertion of the Achilles tendon into the posterior aspect of the calcaneus, and the two can be considered overlapping, but different, conditions.(3) One hypothesis of the causation of the mid-substance tendinopathy is from the relatively hypovascular nature of this region,(4) however an internal compression theory has also been postulated.(3) The site of the insertional Achilles tendinopathy is also a site of compression and this has again been postulated as a causative factor.(3) Achilles tendinopathy was originally considered an inflammatory process, however many studies have shown that the degenerative pathology found is more akin to a failed healing process.(1, 5-7) Neovascularity, the ingrowth of abnormal blood vessels penetrating the tendon, is often seen in chronic Achilles tendinopathy and are associated with the site of maximal tenderness and maximal thickening of the abnormal tendon.(8, 9) Neuropathic pain may be a component of pain in patients with established Achilles tendinopathy.(10) Whilst biomechanical factors almost certainly play a part in the development of Achilles tendinopathy, it remains unclear which biomechanical faults are of primary importance leading to uncertainties about methods of improving function in those with established tendinopathy, or seeking to prevent it starting.(11)

Achilles tendinopathy of both types most commonly affects active adults between the ages of 30 and 60, particularly those engaged in racquet sports, track and field,

volleyball and soccer.(9, 12-14) Runners have a 30-fold increase in Achilles tendinopathy symptoms compared to non-runners below the age of 35, with annual incidences of Achilles tendinopathy in all runners about 10%(15, 16) However about one-third of cases are not related to activity and it may be that activity is more important in provoking symptoms rather than being the cause of the condition itself in general populations.(17, 18) In addition to activity, Achilles tendinopathy is associated with a range of other co-morbidities including obesity, the use of oral contraceptives or HRT.(19, 20)

The prognosis for patients with mid-substance Achilles tendinopathy is varied. A large observational study with an eight year follow-up, showed that 84% of patients had returned to their pre-morbid activity levels and 94% of patients were asymptomatic, or had only minimal pain.(21) Most patients with Achilles tendinopathy will improve with simple conservative measures,(1, 22, 23) however surgery may be required in a quarter to a third of cases.(12, 21) Eccentric-based rehabilitation exercises have the most evidence of benefit of any of the conservative management options, and were found in several systematic reviews to be superior to either concentric-based exercise programmes, or tension-night splints.(23-26) A newer option for chronic mid-substance Achilles tendinopathy is the use of High-Volume Image-Guided Injections (HVIGI) with evidence from case series and cohort studies suggesting improvement in the majority of cases,(27, 28) but there is no published evidence yet from RCTs proving effectiveness.

Insertional Achilles tendinopathy tends to be more recalcitrant than mid-substance tendinopathy to a range of treatment options,(29, 30) however there is a consensus that conservative management options should be tried before surgical options are considered.(31) The evidence is limited, but there have been found to be benefits from both a modified eccentric loading programme and shockwave therapy (ESWT) as conservative options,(32, 33) Differential diagnoses of seronegative arthropathies need to be considered with patients presenting with insertional Achilles

tendinopathy symptoms, as unlike mid-substance this is a common site for seronegative disease involvement.(34-36)

In patients who have failed a rehabilitation programme, Extra-Corporeal Shockwave Therapy (ESWT) have some evidence of benefit for the treatment of both insertional and non-insertional Achilles tendinopathy reported in several separate systematic reviews.(32, 33) These have shown that ESWT is more effective than eccentric loading for insertional Achilles tendinopathy, at least as good as eccentric loading for mid-substance Achilles tendinopathy, and that combining Extra-Corporeal Shockwave Therapy with eccentric-based rehabilitation gives better results than either intervention on its own.(33) However, many primary studies involve only small numbers of cases, often with relatively short duration of symptoms, and often only simple measures of pain and local function are used to record outcome rather than global markers of health and function. This study sets out to examine the outcomes following ESWT plus rehabilitation in general populations presenting to a secondary care hospital clinic with chronic Achilles tendinopathy and investigate the feasibility and usefulness of a range of different patient-rated outcome measures to give a more global view of pain and the impact that pain has on a range of domains of function.

Patients/Materials and Methods

Patients with chronic Achilles Tendinopathy have been treated by the author (PCW) within a single NHS Sports Medicine department in a secondary care hospital in the UK using Extra-Corporeal Shockwave Therapy (ESWT). This included patients with insertional Achilles tendinopathy, and non-insertional (sometimes referred to as mid-substance) Achilles tendinopathy. Data presented here is from the period September 2014 to July 2016. In line with other hospital procedures, written consent forms were used to record consent before the first session of ESWT.

Patients had sessions of ESWT performed by the same practitioner, once per week for three weeks using an “Intelect” RPW ESWT machine (DJO Global Chattanooga). Rather than a set dose, in keeping with routine clinical use and manufacturer instructions, the energy dose was controlled by the operator to a “maximal comfortably-tolerated” energy dose which was individual for different patients and varied between sessions. Both groups used manufacturer specified settings of 10.0Hz and 2000 shocks per treatment. For the patients with non-insertional tendinopathy the energy doses were a mean ±SD of 2.1 ±0.3 bar for the 1st ESWT session, 2.6 ±0.3 for the 2nd, and 2.9 ±0.4 for the 3rd. For those with insertional tendinopathy the figures were 2.2 ±0.4 bar / 2.7 ±0.6 / 3.1 ±0.7 respectively. Following shockwave, patients were given standardised post-procedural advice and were advised to avoid NSAIDs for the day of, and a few days after, each session of ESWT.

Before undergoing shockwave therapy, patients were taught to perform a structured home exercise programme including flexibility of the lower limb, specific isometric and eccentric strengthening (through full-range for patients with non-insertional Achilles tendinopathy, but to neutral only in patients with insertional Achilles tendinopathy), as well as core stability and proprioception exercises. These exercises were prompted at each of the subsequent clinic visits to promote adherence and facilitate progression. Patients were advised that these exercises could be uncomfortable, particularly to begin with, and were taught how to manage and progress these exercises. To support the use of the home exercise programme, patients were all given written sheets discussing these exercises and reminding them of technique and how often these need to be performed for optimal benefit.

- Data collection

In this prospective case series study, patients with both insertional and non-insertional Achilles tendinopathy were treated with undertaking shockwave therapy. Patients completed a structured questionnaire about their symptoms before treatment and at each subsequent follow-up visit. All data was collected contemporaneously. The

outcome measures included questions about pain, as well as a range of validated Patient-Rated Outcome Measures (PROMs). This included ones about specific Achilles and foot/ankle function (VISA-A, and Foot-Ankle Ability Measure (FAAM measures of global function (EQ-5D-5L) and a questionnaire that examined measures of anxiety and depression symptoms (Hospital Anxiety and Depression Scale – HADS). In addition, the short-form (7-day recall) version of the International Physical Activity Questionnaire (IPAQ) was used to quantify levels of physical activity. These measures were used to examine different aspects of functioning following the ESWT procedure. Table 1 displays information for each of the PROMs used.

Patients were followed up at six-week, three-months and six-months following ESWT.

Based on prior literature base and clinical rationale, the primary outcome measure was a change in average pain (as recorded on a 0-10 scale) between baseline and three-months post-ESWT, with the remainder of the outcome measures studied being secondary measures to this. All data was recorded prospectively.

- Ethical considerations

In line with local policy, the ESWT procedure was registered with the hospital's New Intervention Procedure Group (NIPAG) and data are recorded here in the format of a service evaluation project and audit. Patients were informed of the use of the questionnaires that they self-completed, consented for data useage, and all data was anonymized prior to use.

- Statistical analysis

Data was recorded prospectively at baseline, and on an on-going basis at clinic follow-up and collated into an Excel spreadsheet (MS Excel from MS Office 2011, version 14.5.7) and analysed in SPSS (IBM SPSS Statistics, version 22). From this dataset the majority of the outcome measures are scale data. Comparisons were made

between the baseline data and data from the six-week, the three-month, and where data was present the six-month follow-up appointments. As the sample sizes were small, the Shapiro-Wilk test was used to assess normality and as the majority of the data was found to be not normally distributed the majority of the analysis was performed with non-parametric tests, typically the Wilcoxon Signed-Rank Test to look at pre/post differences within groups, and the Mann-Whitney test to compare subjects between groups. Statistical significance was set at $p<0.05$

Results

Data was obtained for a total of 39 patients during the study period; 30 were for patients with insertional Achilles tendinopathy, 9 were for patients with non-insertional (mid-substance) Achilles tendinopathy. Patients with insertional tendinopathy tended to be slightly older and with a longer duration of symptoms pre-ESWT, but this difference did not reach statistical significance. There was a mean follow up of 163 days (minimum 65, maximum 385 days.) During this period, 6/30 (23%) of the subjects with insertional Achilles tendinopathy required further intervention for their symptoms, compared to 4/9 (44%) of those with non-insertional Achilles tendinopathy, however this difference was not found to be significant ($p=0.414$) The baseline demographics and baseline PROMs are displayed in Table 2, with median and interquartile range (IQR) values used as the majority of the data was found to be non-parametric. There were no statistically significant differences between members of the two anatomical sites for any of the baseline parameters studied.

Subjects were reviewed at 6 weeks, 3-months and 6-months to assess progress. This information is displayed for patients with insertional Achilles tendinopathy (Table 3) and non-insertional Achilles tendinopathy (Table 4). Data was not available for all patients at all time periods, either due to missed, postponed or cancelled appointments, or patients not reaching that specific time-period within the data collection period.

All patients tolerated all three sessions of shockwave therapy with no more than mild discomfort which was transitory. No significant complications were reported from patients treated.

For subjects with insertional Achilles tendinopathy, self-reported “average” pain changed from a median of 6.5/10 (IQR: 5.0-7.8) at baseline, to 5.0/10 (3.5-5.0) at 6-weeks, 3.5/10 (2.0-5.21) at 3-months, and 2.0/10 (0.6-4.8) at 6-months. (Interquartile ranges are also displayed in table 3 for clarity.) All of these follow-up periods improved from baseline to a statistically significant extent. In addition, many of the other parameters studied also improved at follow-up. This included markers of potential neuropathic pain (PainDETECT) which improved significantly from a median of 15.0 at baseline to 10.5 at 3-months and 9.5 at 6-months, as well as Achilles/ankle function questionnaires (VISA-A and the FAAM-ADL) both of which improved significantly at all time-points studied. Despite these improvements in pain and function seen, no consistent correlating improvements in overall levels of physical activity were seen using the short-form IPAQ. Furthermore, markers of global health or mental health functioning (EQ-5D and HAD) did not change significantly at follow-up compared to baseline. The specific values for the different PROMs used for patients with insertional Achilles tendinopathy are displayed in table 3, with an asterisk (*) indicating a statistical significant change ($p<0.05$) from baseline figures. Figures displayed are median (IQR)

Median values for self-reported “average pain” in subjects with non-insertional Achilles tendinopathy changed from 7.0/10 to 6.0/10 at 6-weeks ($p=0.068$), to 6.0/10 at 3-months ($p=0.075$), and to 6.0/10 at 6-months ($p=0.109$). None of these differences in self-reported average pain reached statistical significance, nor did any changes in self-reported “worst pain” or “stiffness”, except at 3-months with a statistically significant improvement in “worst pain” from 9.0 at baseline to 8.0 at 3-months. Examining the remaining PROMs, the only value which reached a statistically significant difference was the VISA-A, improving from 24% at baseline to 44% at 3-months which reached statistical significance only at 3-months, but not at 6-weeks or 6-months. both at 3

months compared to baseline. The other marker of foot & ankle function, the FAAM did not alter significantly at any time point studied for patients with non-insertional tendinopathy. Similar to those with insertional tendinopathy, the markers of global health (ED-5D), mental health functioning (HAD), or physical activity (short-form IPAQ) did not differ significantly at the follow-up time points studied, compared to baseline. The specific values for the different PROMs used are displayed in table 4 for patients with non-insertional Achilles tendinopathy, with an asterisk (*) indicating a statistical significant change ($p<0.05$) from baseline figures. Figures displayed are median (IQR)

To compare effectiveness for patients with insertional versus non-insertional tendinopathy, direct comparison in several specific PROMs was made using any changes from baseline to 3-months, which was the time period with the greatest proportion of data and the primary outcome period of interest. This form of analysis also takes account of any missing data at this time-point, either from patients not attending follow-up appointments, or those that had not yet reached that particular time-period post-procedure. Overall, no significant difference was seen in the changes in any of the parameters studied between subjects with either insertional or non-insertional Achilles tendinopathy. Figures from this are displayed in table 5, with figures shown median values (IQR) and a positive value representing an improvement in each score at three-months from baseline levels.

In addition to the measures discussed above, patients were asked to self-select at each appointment which of the stages of a Roles and Maudsley score best represented their current situation. This is a 1-4 categorical system, with a lower score indicating a better outcome at that point. 1 = “I have no symptoms or minimal symptoms now”, 2 = I have some symptoms, but these are significantly improved from before the treatment, 3 = “I have some ongoing symptoms, but these are somewhat better from before the treatment”, 4 = “My symptoms are no better, or worse than before the treatment” Overall there were no significant differences at any of the time points in the Roles & Maudsley score between subject with insertional and non-insertional Achilles

tendinopathy. These values are displayed in table 6, with figures shown being median (IQR)

Discussion

Overall, beneficial results were obtained for patients with insertional and non-insertional Achilles tendinopathy following a combination of Extra-Corporeal Shockwave Therapy and a home rehabilitation. This study has been able to show improvements in a wide range of different patient-rated outcome measures. One of the strengths of this study is the use of different outcome measures to assess pain, function, mood and activity and this has shown improvements in some, but not all domains. Although causality of benefit cannot be shown from this study design, the overall results here are in keeping with other published evidence demonstrating benefit from Extra-Corporeal Shockwave Therapy and which may reduce the need for other treatments including surgical intervention.

Based on a review of the literature and to the best knowledge of the author, this is the first paper to directly compare a group of patients with non-insertional and insertional Achilles tendinopathy to explore any differences between outcomes from these two similar, but distinct, conditions. From the comparisons between patients with insertional and non-insertional Achilles tendinopathy, there was a suggestion that patients with insertional tendinopathy received greater benefits. However, the differences seen, did not reach statistical significance, however these may have been affected by the limited numbers included in this study, and further work may be required.

Whilst pain is commonly reported as a barrier to physical activity in patients with Achilles tendinopathy, although significant improvements in pain were demonstrated in patients with both non-insertional and insertional Achilles tendinopathy, no consistent

benefits were recorded in rates of physical activity undertaken. It may be that further interventions are required to specifically increase rates of physical activity in this patient population. Due to the numerous health benefits from regular physical activity, this is an important area worthy of further consideration in future research.

This study involved only small number of patients particularly with non-insertional Achilles tendinopathy, who have traditionally undergone different treatments in this hospital department in which this study was based. The follow-up period of this study was relatively short, and longer-term follow-up is required to assess any persisting benefits. Larger studies using similar outcome measures with longer follow up periods may be helpful to examine these areas in more detail. Furthermore, no specific record was kept as to analgesic use before/during/following procedure to see if this is reduced by the use of ESWT, this should be factored into further study designs to give more reliable marker of any benefit, and to take account of this possible confounding factor.

It is hoped that this study can add to the gathering evidence suggesting benefit in the treatment of patients with recalcitrant Achilles tendinopathy, of both non-insertional and insertional variants. Furthermore, it is hoped that further discussion can be made to harmonise outcome measures used between different studies to give a more holistic view of patient functioning, and allow direct comparison across different domains for different studies, procedures, and conditions. The data from this study could be used to develop more robust study designs specifically to investigate the effectiveness of ESWT across different domains of patient function for patient Although causality of benefit cannot be shown from this study design, the results here are in keeping with other published evidence demonstrating a benefit from ESWT previously discussed with both insertional and non-insertional Achilles tendinopathy.

Acknowledgement/s

The author would like to offer his thanks to Chloe Tattersall, Nurse Practitioner in the Sports Medicine Department for her assistance in performing the shockwave therapy for some of the patients in this study.

References

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342 **Table/s**

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Outcome measure	Assessing	Scale	Notes
Victoria Institute of Sport Assessment – Achilles (VISA-A)	Function of Achilles	%scale	Higher values indicate better function (but large weighting to activity score which may bias results against those not habitually active)
Foot-Ankle Ability Measure (FAAM) %ADL	Function of foot/ankle	sub-score for activities of daily living displayed, %scale, range 0-100%	Higher score indicates better function
painDETECT (pD)	Potential markers of neuropathic pain	0-38	Lower score suggests lower likelihood of neuropathic pain: (0-12 = neuropathic pain unlikely, 13-18 uncertain, 19-39 neuropathic pain likely)
EQ-5D-5L	Global health status	Health score displayed, range 0-100%	Higher score indicates better self-rated global health
Hospital Anxiety & Depression Scale	Measure of anxiety and depression	Anxiety & Depression sub-	Lower score indicates fewer

(HADS)	symptoms	scales, each range 0-21	symptoms
International Physical Activity Questionnaire (IPAQ) – 7-day recall version	Assessment of physical activity undertaken in the previous 7 days	Scores of minutes of activity per week spent walking, in moderate activity, and in vigorous activity, and in hours of sitting on a weekday	Increased levels of physical activity, or lower levels of sedentary behaviour, are associated with significant health benefits.

346 **Table 1:** Patient-rated Outcome Measures (PROMs) used

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Figures are median (interquartile range)	**Insertional Achilles tendinopathy** (n=30)	**Non-insertional Achilles tendinopathy** (n=9)	*p-value*
%male	50%	44%	*0.930*
age (years)	55.4 (46.4,60.6)	46.3 (40.3, 56.4)	*0.093*
Symptom duration in months	21.0 (12.0, 30.0)	18.0 (10.0, 24.0)	*0.544*
Self-reported “average” pain (0-10 scale)	6.5 (5.0,7.8)	7.0 (7.0, 8.0)	*0.131*
Self-reported “worst” pain (0-10 scale)	8.0 (7.0, 9.0)	9.0 (8.5, 9.0)	*0.100*
Self-reported “stiffness” (0-10 scale)	6.0 (3.0, 7.0)	7.0 (3.0, 7.0)	*0.736*
PainDETECT	15.0 (13.3, 19.8)	18.0 (13.0, 20.0)	*0.949*
VISA-A	28% (22%, 46%)	24% (20%, 29%)	*0.248*
FAAM-ADL %	57% (45%, 68%)	55% (44%, 59%)	*0.592*
IPAQ – self-reported minutes of vigorous activity per week	0 (0,146)	0 (0, 30)	*0.736*
IPAQ - self-reported minutes of moderate activity per week	15 (0,68)	0 (0, 0)	*0.349*
IPAQ - self-reported minutes of walking per week	300 (28,840)	75 (14, 210)	*0.538*
IPAQ - self-reported hours of sitting on a typical weekday	4.0 (3.1, 6.6)	4.0 (4.0, 7.0)	*0.781*
“vital signs”- self-reported minutes of activity per week	58 (0, 188)	10 (0, 22)	*0.254*

EQ-5D - % health	70% (52%, 86%)	60% (52%, 75%)	*0.433*
HAD – Anxiety sub-scale	5.0 (2.0, 7.5)	7.0 (3.0, 8.0)	*0.483*
HAD – Depression sub-scale	3.0 (1.5, 7.0)	5.0 (3.0, 9.0)	*0.263*

Table 2: Biographic and baseline PROMs data for subjects treated for insertional and non-insertional Achilles tendinopathy symptoms. *Figures are median (IQR)*

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Insertional Achilles tendinopathy	baseline (n=30)	6-weeks (n=24)	3-months (n=24)	6-months (n=18)
Self-reported “average pain” (0-10 scale)	6.5 (5.0,7.8)	5.0 * (3.5, 5.0)	3.5 * (2.0, 5.1)	2.0 * (0.6, 4.8)
Self-reported “worst pain” (0-10 scale)	8.0 (7.0, 9.0)	6.5 * (5.3, 7.4)	5.8 * (3.0, 7.0)	5.0 * (3.0, 6.0)
Self-reported “stiffness” (0-10 scale)	6.0 (3.0, 7.0)	3.8 * (3.0, 6.0)	3.0 * (2.0, 6.0)	3.0 * (1.0, 4.8)
PainDETECT	15.0 (13.3, 19.8)	13.0 (10.5, 16.0)	10.5 * (8.0, 17.3)	9.5 * (6.5, 12.3)
VISA-A	28% (22%, 46%)	48% * (32%, 64%)	55% * (42%, 68%)	60% * (49%, 73%)
FAAM-ADL %	57% (45%, 68%)	68% * (52%, 82%)	71% * (62%, 91%)	85% * (73%, 94%)
IPAQ – self-reported minutes of vigorous activity per week	0 (0,146)	60 (0, 240)	0 (0, 135)	110 (0, 293)
IPAQ - self-reported minutes of moderate activity per week	15 (0,68)	80 (0, 180)	90 * (0, 330)	60 * (0, 255)
IPAQ - self-reported minutes of walking per week	300 (28,840)	360 (105, 840)	390 (90, 855)	390 (210, 735)
IPAQ - self-reported hours of sitting on a typical weekday	4.0 (3.1, 6.6)	4.5 (3.0, 8.0)	4.0 (3.0, 6.0)	4.0 (3.0, 8.0)
“vital signs”- self-reported minutes of activity per week	58 (0, 188)	160 (80, 270)	100 (0,248)	65 (0, 158)
EQ-5D - % health	70% (52%, 86%)	70% (60%, 85%)	78% (70%, 80%)	85% (78%, 95%)

HAD – Anxiety sub-scale	5.0 (2.0, 7.5)	4.0 (1.8, 8.0)	5.0 (2.5, 7.0)	3.0 (1.8, 5.3)
HAD – Depression sub-scale	3.0 (1.5, 7.0)	3.5 (1.8, 4.3)	3.0 (1.5, 4.0)	2.0 (1.0, 3.0)

Table 3: Displaying PROMs data for subjects with insertional Achilles tendinopathy at baseline and follow-up periods. *Figures are median (IQR) (* = change from baseline reached statistical significance (p<0.05) but absolute values not displayed for clarity)*

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Non-insertional Achilles tendinopathy	baseline (n=9)	6-weeks (n=6)	3-months (n=9)	6-months (n=4)
Self-reported “average pain” (0-10 scale)	7.0 (7.0, 8.0)	6.0 (5.6, 6.8)	6.0 (3.0, 7.0)	6.0 (3.8, 7.0)
Self-reported “worst pain” (0-10 scale)	9.0 (8.5, 9.0)	7.0 (5.9, 7.8)	8.0 * (5.0, 8.0)	8.5 (6.5, 9.3)
Self-reported “stiffness” (0-10 scale)	7.0 (3.0, 7.0)	5.0 (3.3, 6.4)	6.0 (4.0, 6.5)	3.0 (1.5, 5.0)
PainDETECT	18.0 (13.0, 20.0)	15.5 (12.8, 16.0)	14.0 (5.0, 19.0)	14.5 (9.8, 17.5)
VISA-A	24% (20%, 29%)	38% (36%, 40%)	44% * (39%, 48%)	33% (26%, 46%)
FAAM-ADL %	55% (44%, 59%)	56% (43%, 60%)	60% (48%, 76%)	71% (61%, 84%)
IPAQ – self-reported minutes of vigorous activity per week	0 (0, 30)	5 (0, 115)	20 (0, 36)	0 (0, 5)
IPAQ - self-reported minutes of moderate activity per week	0 (0, 0)	5 (0, 25)	12 (0, 30)	0 (0, 15)
IPAQ - self-reported minutes of walking per week	75 (14, 210)	15 (0, 165)	60 (16, 350)	220 (162, 390)
IPAQ - self-reported hours of sitting on a typical weekday	4.0 (4.0, 7.0)	5.5 (2.8, 6.0)	6.0 (4.0, 8.0)	6.8 (5.3, 8.0)
“vital signs”- self-reported minutes of activity per week	10 (0, 22)	14 (0, 120)	30 (0, 44)	20 (0, 65)
EQ-5D - % health	60% (52%, 75%)	73% (62%, 79%)	70% (50%, 78%)	60% (50%, 69%)
HAD – Anxiety sub-scale	7.0	6.0	7.0	7.5

	(3.0, 8.0)	(3.8, 7.5)	(4.0, 8.0)	(4.5, 9.8)
HAD – Depression sub-scale	5.0 (3.0, 9.0)	4.5 (0.5, 8.5)	6.0 (3.0, 7.0)	8.5 (4.5, 11.8)

Table 4: Displaying PROMs data for subjects with non-insertional Achilles tendinopathy at baseline and follow-up periods. *Figures are median (IQR) (* = change from baseline reached statistical significance (p<0.05) but absolute p-values not displayed for clarity)*

Change in values from baseline to 3-months	**Insertional Achilles tendinopathy (n=24)**	**Non-insertional Achilles tendinopathy (n=9)**	*p-value*
Self-reported “average” pain (0-10 scale)	2.0 (1.0, 3.3)	1.0 (0.0, 4.0)	*0.437*
Self-reported “worst” pain (0-10 scale)	2.0 (0.5, 4.0)	1.0 (0.0, 2.0)	*0.301*
Self-reported “stiffness” (0-10 scale)	2.0 (-0.8, 3.0)	1.0 (0.0, 1.5)	*0.363*
PainDETECT	4.0 (2.0, 7.0)	1.5 (1.0, 5.0)	*0.220*
VISA-A	23% (0%, 43%)	11% (7%, 22%)	*0.617*
FAAM-ADL %	12% (1%, 27%)	12% (-7%, 23%)	*0.699*

Table 5: Displaying change in PROMs data for subjects with insertion and non-insertional Achilles tendinopathy from baseline to three-month follow-up periods. (Positive figure indicating improvement, negative figure indicating deterioration in condition. Significance figures calculating difference between the two groups) *Figures are median (IQR)*

Roles & Maudsley score	**Insertional Achilles tendinopathy**	**Non-insertional Achilles tendinopathy**	*p-value*
6-weeks	3.0 (2.0, 3.0)	3.0 (2.3, 3.0)	*1.000*
3-months	3.0 (2.0, 3.0)	3.0 (2.0, 4.0)	*0.359*
6-months	2.0 (1.0, 3.0)	3.5 (3.0, 4.0)	*0.228*

Table 6: Displaying Roles & Maudsley score at each follow-up time point comparing results for subjects with insertional and non-insertional Achilles tendinopathy. *Figures are median (IQR)*

References

1. Alfredson H, Cook J. A treatment algorithm for managing Achilles tendinopathy: new treatment options. British Journal of Sports Medicine 41: 211, 2007
2. de Jonge S, van den Berg C, de Vos RJ, van der Heide HJL, Weir A, Verhaar JAN, Bierma-Zeinstra SMA, Tol JL. Incidence of midportion Achilles tendinopathy in the general population. British Journal of Sports Medicine 45: 1026, 2011
3. Cook J, Purdam C. Is compressive load a factor in the development of tendinopathy? British Journal of Sports Medicine 46: 163, 2012
4. Chen TM, Rozen WM, Pan W-r, Ashton MW, Richardson MD, Taylor GI. The arterial anatomy of the Achilles tendon: Anatomical study and clinical implications. Clinical Anatomy 22: 377, 2009
5. Resteghini P, Yeoh J. High-volume injection in the management of recalcitrant mid-body Achilles tendinopathy: a prospective case series assessing the influence of neovascularity and outcome. International Musculoskeletal Medicine 34: 92, 2012
6. Cook JL, Purdam CR. Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy. British Journal of Sports Medicine 43: 409, 2009
7. Abate M, Silbernagel KG, Siljeholm C, Di Iorio A, De Amicis D, Salini V, Werner S, Paganelli R. Pathogenesis of tendinopathies: inflammation or degeneration? Arthritis Research & Therapy 11, 2009
8. Divani K, Chan O, Padhiar N, Twycross-Lewis R, Maffulli N, Crisp T, Morrissey D. Site of maximum neovascularisation correlates with the site of pain in recalcitrant mid-tendon Achilles tendinopathy. Manual Therapy 15: 463, 2010
9. Alfredson H. Chronic midportion Achilles tendinopathy: an update on research and treatment. Clinics in Sports Medicine 22: 727, 2003
10. Wheeler PC. Neuropathic pain may be common in chronic lower limb tendinopathy; a prospective cohort study. British Journal of Pain 11: 16, 2017
11. Munteanu S, Barton C. Lower limb biomechanics during running in individuals with achilles tendinopathy: a systematic review. J Foot Ankle Res 4: 1, 2011
12. Alfredson H, Lorentzon R. Chronic Achilles Tendinosis. Sports Med 29: 135, 2000
13. Maffulli N, Sharma P, Luscombe KL. Achilles tendinopathy: aetiology and management. Journal of the Royal Society of Medicine 97: 472, 2004
14. Cook JL, Khan KM, Purdam C. Achilles tendinopathy. Manual Therapy 7: 121, 2002
15. Kujala UM, Sarna S, Kaprio J. Cumulative Incidence of Achilles Tendon Rupture and Tendinopathy in Male Former Elite Athletes. Clinical Journal of Sport Medicine 15: 133, 2005
16. Lopes AD, Hespanhol LC, Jr., Yeung SS, Costa LOP. What are the Main Running-Related Musculoskeletal Injuries? Sports Med 42: 891, 2012
17. Rolf C, Movin T. Etiology, Histopathology, and Outcome of Surgery in Achillodynia. Foot & Ankle International 18: 565, 1997
18. Astrom M. Partial rupture in chronic Achilles tendinopathy. A retrospective analysis of 342 cases. Acta Orthop Scand 69: 404, 1998

19. Holmes GB, Lin J. Etiologic Factors Associated with Symptomatic Achilles Tendinopathy. Foot & Ankle International 27: 952, 2006
20. Scott RT, Hyer CF, Granata A. The Correlation of Achilles Tendinopathy and Body Mass Index. Foot & Ankle Specialist 6: 283, 2013
21. Paavola M, Kannus P, Paakkala T, Pasanen M, Järvinen M. Long-Term Prognosis of Patients With Achilles Tendinopathy: An Observational 8-Year Follow-up Study. The American Journal of Sports Medicine 28: 634, 2000
22. Mayer F, Hirschmüller A, Müller S, Schuberth M, Baur H. Effects of short-term treatment strategies over 4 weeks in Achilles tendinopathy. British Journal of Sports Medicine 41: e6, 2007
23. Magnussen RA, Dunn WR, Thomson AB. Nonoperative Treatment of Midportion Achilles Tendinopathy: A Systematic Review. Clinical Journal of Sport Medicine 19: 54, 2009
24. Kingma JJ, de Knikker R, Wittink HM, Takken T. Eccentric overload training in patients with chronic Achilles tendinopathy: a systematic review. British Journal of Sports Medicine 41: e3, 2007
25. Alfredson H, Pietilä T, Jonsson P, Lorentzon R. Heavy-Load Eccentric Calf Muscle Training For the Treatment of Chronic Achilles Tendinosis. The American Journal of Sports Medicine 26: 360, 1998
26. Öhberg L, Lorentzon R, Alfredson H. Eccentric training in patients with chronic Achilles tendinosis: normalised tendon structure and decreased thickness at follow up. British Journal of Sports Medicine 38: 8, 2004
27. Wheeler PC. The use of High-Volume Image-Guided Injections (HVIGI) for Achilles tendinopathy - a case series & pilot study. International Musculoskeletal Medicine 36: 96, 2014
28. Wheeler P, Mahadevan D, Bhatt R, Bhatia M. A comparison of two different High-Volume Image-Guided Injection procedures for patients with chronic non-insertional Achilles Tendinopathy. Journal of Foot & Ankle Surgery 55: 976, 2016
29. Van Dijk CN, Van Sterkenburg MN, Wiegerinck JI, Karlsson J, Maffulli N. Terminology for Achilles tendon related disorders. Knee Surg Sports Traumatol Arthrosc 19: 835, 2011
30. Fahlström M, Jonsson P, Lorentzon R, Alfredson H. Chronic Achilles tendon pain treated with eccentric calf-muscle training. Knee Surg Sports Traumatol Arthr 11: 327, 2003
31. Kearney R, Costa ML. Insertional Achilles Tendinopathy Management: A Systematic Review. Foot & Ankle International 31: 689, 2010
32. Al-Abbad H, Simon JV. The effectiveness of extracorporeal shock wave therapy on chronic Achilles tendinopathy: a systematic review. Foot & ankle international / American Orthopaedic Foot and Ankle Society [and] Swiss Foot and Ankle Society 34: 33, 2013
33. Mani-Babu S, Morrissey D, Waugh C, Screen H, Barton C. The Effectiveness of Extracorporeal Shock Wave Therapy in Lower Limb Tendinopathy: A Systematic Review. The American Journal of Sports Medicine 43: 752, 2015
34. Gerster JC. Plantar Fasciitis and Achilles Tendinitis among 150 cases of seronegative spondarthritis. Rheumatology 19: 218, 1980

35. De Simone C, Guerriero C, Giampietruzzi AR, Costantini M, Di Gregorio F, Amerio P. Achilles tendinitis in psoriasis: clinical and sonographic findings. Journal of the American Academy of Dermatology 49: 217, 2003
36. Olivieri I, Barozzi L, Padula A, De Matteis M, Pavlica P. Clinical manifestations of seronegative spondylarthropathies. European journal of radiology 27, Supplement 1: S3, 1998