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Extracorporeal Shock Wave Therapy Plus Rehabilitation for Insertional and Noninsertional Achilles Tendinopathy Shows Good Results Across a Range of Domains of Function

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ABSTRACT

Achilles tendinopathy, both insertional and noninsertional, is a common cause of posterior ankle pain. Although the condition of most patients improves with simple conservative measures, a proportion will go on develop chronic symptoms. This study examines the outcomes of patients following extracorporeal shock wave therapy plus a home exercise program. This prospective case series study involves a total of 39 patients, with a mean follow-up duration of 163 (range 65 to 385) days. This has demonstrated significant benefits in pain, stiffness, and a range of measures of local and global function. Median (interquartile range [IQR]) values for average self-reported pain improved from 6.5 of 10 (IQR 5.0 to 7.8) at baseline to 3.5 of 10 (IQR 2.0 to 5.1) at 3 months and to 2.0 of 10 (IQR 0.6 to 4.8) at 6 months for patients with insertional Achilles tendinopathy. This compares to improvements from 7.0 of 10 (IQR 7.0 to 8.0) at baseline to 6.0 of 10 (IQR 5.6 to 6.8) at 3 months and to 6.0 of 10 (IQR 3.0 to 7.0) at 6 months for patients with noninsertional Achilles tendinopathy. Statistically significant improvements were seen in insertional tendinopathy across a range of outcome measures; however, these were less apparent for patients with noninsertional tendinopathy. Despite these figures, no significant differences were seen in the outcomes for patients with insertional and noninsertional tendinopathy. Despite the improvements seen in the aspects of pain and function, physical activity levels had not increased following the treatment.

Rather than a single clinical entity, 2 distinct anatomic locations of Achilles tendinopathy are described. The more common site is in the midportion 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 of 2.35 per 1000 adults in primary care (2). A less common type affects the insertion of the Achilles tendon into the posterior aspect of the calcaneus, and the 2 can be considered overlapping, but different, conditions (3). One hypothesis of the causation of the midsubstance 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 the abnormal blood vessels penetrating the tendon, is often seen in chronic Achilles tendinopathy and is 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). Although 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 the methods of improving function in those with established tendinopathy or in those seeking to prevent it from starting (11).

Achilles tendinopathy of both types most commonly affects active adults between the ages of 30 and 60 years, particularly those engaged in racket sports, track and field, volleyball, and soccer (9,12–14). Runners have a 30-fold increase in Achilles tendinopathy symptoms compared with nonrunners aged <35 years, with annual incidences of Achilles tendinopathy of about 10% in all runners (15,16). However, about one third of the cases are not related to activity, and it may be that activity is more important in provoking symptoms rather than

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being the cause of the condition in general populations (17,18). In addition to activity, Achilles tendinopathy is associated with a range of other comorbidities, including obesity, the use of oral contraceptives, and hormone replacement therapy (19,20).

The prognosis for patients with midsubstance Achilles tendinopathy is varied. A large observational study with an 8-year follow-up showed that 84% of patients returned to their premorbid activity levels and 94% of patients were asymptomatic or had only minimal pain (21). The condition of most patients with Achilles tendinopathy improves with simple conservative measures (1,22,23); however, surgery may be required in a quarter to one third of the 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 programs or tension-night splints (23–26). A newer option for chronic midsubstance Achilles tendinopathy is the use of high-volume image-guided injections, with evidence from case series and cohort studies suggesting improvement in most cases (27,28), but there is no published evidence yet from randomized controlled trial to prove its effectiveness.

Insertional Achilles tendinopathy tends to be more recalcitrant than midsubstance tendinopathy to a range of treatment options (29,30); however, there is a consensus that conservative management options should be tried before considering surgical options (31). The evidence is limited but suggests benefits from both a modified eccentric loading program and extracorporeal shock wave therapy (ESWT) as conservative options (32,33). Differential diagnoses of seronegative arthropathies need to be considered for patients presenting with symptoms of insertional Achilles tendinopathy, because unlike midsubstance tendinopathy, insertional Achilles tendinopathy is a common site for the involvement of seronegative disease (34–36).

In patients who have failed a rehabilitation program, ESWT has some evidence of benefit for the treatment of both insertional and noninsertional 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 midsubstance Achilles tendinopathy, and that combining ESWT 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 to investigate the feasibility and usefulness of a range of different patient-reported outcome measures (PROMs) to give a more global view of pain and the impact that pain has on a range of domains of function.

Patients and Methods

Patients with chronic Achilles tendinopathy were treated by the author (P.C.W.) within a single National Health Service sports medicine department in a secondary care hospital in the United Kingdom, using ESWT. This included patients with insertional Achilles tendinopathy and noninsertional (sometimes referred to as midsubstance) Achilles tendinopathy. The data presented here are from September 2014 to July 2016. In line with other hospital procedures, written consent forms were used to record patients' consent before their first session of ESWT.

Patients had sessions of ESWT performed by the same practitioner, once per week for 3 weeks, using an Intelect® Radial Pulse Wave ESWT machine (Chattanooga; DJO Inc., Surrey, England). 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 Hz and 2000 shocks per treatment. For the patients with noninsertional tendinopathy, the energy doses were a mean ± standard deviation of 2.1 ± 0.3 bar, 2.6 ± 0.3 bar, and 2.9 ± 0.4 bar for the first, second, and third sessions, respectively. For those with insertional tendinopathy, the energy doses were a mean ± standard deviation of 2.2 ± 0.4 bar, 2.7 ± 0.6 bar, and 3.1 ± 0.7 for the first, second, and third ESWT sessions, respectively. Patients were given standardized postprocedural advice following shock wave therapy and were advised to avoid nonsteroidal antiinflammatory drugs for the day of, and a few days after, each session of ESWT.

Before undergoing shock wave therapy, patients were taught to perform a structured home exercise program, including flexibility of the lower limb, specific isometric and eccentric strengthening (to full range for patients with noninsertional Achilles tendinopathy but to neutral only in patients with insertional Achilles tendinopathy), and 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 program, all patients were given written sheets that discussed these exercises and reminded them of the 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 noninsertional Achilles tendinopathy were treated with ESWT. Patients completed a structured questionnaire about their symptoms before treatment and at each subsequent follow-up visit. All the data were collected contemporaneously. The outcome measures comprised questions about pain, as well as a range of validated PROMs, including ones about specific Achilles and foot and ankle function (the Victorian Institute of Sport Assessment–Achilles [VISA-A] and Foot and Ankle Ability Measure-Activities of Daily Living [FAAM-ADL]), about measures of global function (5-level version of the EuroQol 5-dimensional questionnaire [EQ-5D-5L]), and about 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 about each of the PROMs used.

Patients were followed up at 6 weeks, 3 months, and 6 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 to 10 scale) between baseline and 3 months post ESWT, with the remainder of the outcome measures studied being secondary measures to this. All data were recorded prospectively.

Ethical Considerations

In line with the local policy, the ESWT procedure was registered with the hospital's New Intervention Procedure Group, and the 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. They consented for data usage, and all data were anonymized prior to use.

Statistical Analysis

The data were recorded prospectively at baseline and on an ongoing basis at the clinic follow-up visit. These were collated into an Excel, version 14.5.7 spreadsheet (Microsoft Corp., Redmond, WA) and analyzed in SPSS version 22 (IBM SPSS Statistics; IBM, Armonk, NY). From this dataset, most of the outcome measures were scale data. Comparisons were made between the baseline data and the data from the 6-week follow-up visit; the 3-month follow-up visit; and, where data were present, the 6-month follow-up visit. The sample sizes were small; therefore, the Shapiro-Wilk test was used to assess normality, and because most of the data were found to be not normally distributed, most of the analysis was performed with nonparametric tests, typically the Wilcoxon rank-sum test to look at the pre-/postdifferences within groups and the Mann-Whitney *U* test to compare subjects between groups. Statistical significance was set at $p < .05$.

Results

The data were obtained for a total of 39 patients during the study period: 30 for patients with insertional Achilles tendinopathy and 9 for patients with noninsertional (midsubstance) 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 days and maximum 385 days). During this period, 6 (23%) of 30 subjects with insertional Achilles tendinopathy required further intervention for their symptoms, compared with 4 (44%) of 9 subjects with noninsertional Achilles tendinopathy. However, this difference was not found to be significant ($p = .414$) The baseline demographics and baseline PROMs are displayed in Table 2, with

Table 1
Patient-reported outcome measures used

Outcome Measure	Assessing	Scale	Notes
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)
FAAM-ADL	Function of foot and ankle	Subscore for activities of daily living displayed; % scale, range 0% to 100%	Higher score indicates better function
pD	Potential markers of neuropathic pain	0 to 38	Lower score suggests lower likelihood of neuropathic pain: (0 to 12 = neuropathic pain unlikely, 13 to 18 = uncertain, 19 to 38 = neuropathic pain likely)
EQ-5D-5L	Global health status	Health score displayed, range 0% to 100%	Higher score indicates better self-rated global health
HADS	Measure of anxiety and depression symptoms	Anxiety and depression subscales, each range 0 to 21	Lower score indicates fewer symptoms
IPAQ: 7-day recall version	Assessment of physical activity undertaken in the previous 7 days	Scores of minutes of activity per week spent in 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 behavior are associated with significant health benefits

Abbreviations: EQ-5D-5L, 5-level version of the EuroQol 5-dimensional questionnaire; FAAM-ADL, Foot and Ankle Ability Measure activities of daily living; HADS, Hospital Anxiety and Depression Scale; IPAQ, International Physical Activity Questionnaire; pD, painDETECT questionnaire; VISA-A, Victorian Institute of Sport Assessment–Achilles.

median and interquartile range (IQR) values used, because most of the data were found to be nonparametric. There were no statistically significant differences between members of the 2 anatomic sites for any of the baseline parameters studied.

Subjects were reviewed at 6 weeks, 3 months, and 6 months to assess the progress. This information is displayed for patients with insertional Achilles tendinopathy in Table 3, and for those with noninsertional Achilles tendinopathy in Table 4. The data were not available for all patients at all time periods, either owing to missed, postponed, or canceled appointments or because patients had not reached that specific time period within the data collection period.

All patients tolerated all 3 sessions of shock wave therapy with no more than mild discomfort, which was transitory. No significant complications were reported from the treated patients.

For subjects with insertional Achilles tendinopathy, self-reported "average" pain changed from a median of 6.5 of 10 (IQR 5.0 to 7.8) at baseline to 5.0 of 10 (IQR 3.5 to 5.0) at 6 weeks, 3.5 of 10 (IQR 2.0 to 5.21) at 3 months, and 2.0 of 10 (IQR 0.6 to 4.8) at 6 months. (The IQR is also displayed in Table 3 for clarity.) All follow-up periods improved from baseline to a statistically significant extent. In addition, many other parameters studied also improved at the follow-up visit. This included markers of potential neuropathic pain (painDETECT questionnaire), which improved significantly from a median of 15.0 at baseline to 10.5 at 3 months and 9.5 at 6 months, and Achilles and foot and ankle function questionnaires (VISA-A and the FAAM-ADL, respectively), both of which improved significantly at all time points studied. Despite these improvements seen in pain and function, no consistent correlating improvements in the overall levels of physical activity were seen by using the short-form IPAQ. Furthermore, markers of global health and mental health functioning (EQ-5D-5L and HADS, respectively) did not change significantly at the follow-up visit, 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 ($p < .05$) from the baseline figures. Figures are displayed as median (IQR).

Table 2
Biographic and baseline patient-reported outcome measures data for subjects treated for insertional and noninsertional Achilles tendinopathy symptoms

	Insertional Achilles Tendinopathy (n = 30)	Noninsertional Achilles Tendinopathy (n = 9)	*p* Value
Male	50%	44%	.930
Age (y)	55.4 (46.4 to 60.6)	46.3 (40.3 to 56.4)	.093
Symptom duration (mo)	21.0 (12.0 to 30.0)	18.0 (10.0 to 24.0)	.544
Self-reported "average" pain (0 to 10 scale)	6.5 (5.0 to 7.8)	7.0 (7.0 to 8.0)	.131
Self-reported "worst" pain (0 to 10 scale)	8.0 (7.0 to 9.0)	9.0 (8.5 to 9.0)	.100
Self-reported "stiffness" (0 to 10 scale)	6.0 (3.0 to 7.0)	7.0 (3.0 to 7.0)	.736
pD	15.0 (13.3 to 19.8)	18.0 (13.0 to 20.0)	.949
VISA-A	28% (22% to 46%)	24% (20% to 29%)	.248
FAAM-ADL	57% (45% to 68%)	55% (44% to 59%)	.592
IPAQ: Self-reported minutes of vigorous activity per week	0 (0 to 146)	0 (0 to 30)	.736
IPAQ: Self-reported minutes of moderate activity per week	15 (0 to 68)	0 (0 to 0)	.349
IPAQ: Self-reported minutes of walking per week	300 (28 to 840)	75 (14 to 210)	.538
IPAQ: Self-reported hours of sitting on a typical weekday	4.0 (3.1 to 6.6)	4.0 (4.0 to 7.0)	.781
"Vital signs": Self-reported minutes of activity per week	58 (0 to 188)	10 (0 to 22)	.254
EQ-5D-5L: Health	70% (52% to 86%)	60% (52% to 75%)	.433
HADS: Anxiety subscale	5.0 (2.0 to 7.5)	7.0 (3.0 to 8.0)	.483
HADS: Depression subscale	3.0 (1.5 to 7.0)	5.0 (3.0 to 9.0)	.263

Abbreviations: EQ-5D-5L, EuroQol 5-dimensional questionnaire; FAAM-ADL, Foot and Ankle Ability Measure activities of daily living; HADS, Hospital Anxiety and Depression Scale; IPAQ, International Physical Activity Questionnaire; pD, painDETECT questionnaire; VISA-A, Victorian Institute of Sport Assessment–Achilles.
Data presented as median (interquartile range), unless otherwise noted.

Table 3
Displaying patient-reported outcome measures data for subjects with insertional Achilles tendinopathy at baseline and follow-up periods

Insertional Achilles Tendinopathy	Baseline (n = 30)	6 Weeks (n = 24)	3 Months (n = 24)	6 Months (n = 18)
Self-reported "average pain" (0 to 10 scale)	6.5 (5.0 to 7.8)	5.0* (3.5 to 5.0)	3.5* (2.0 to 5.1)	2.0* (0.6 to 4.8)
Self-reported "worst pain" (0 to 10 scale)	8.0 (7.0 to 9.0)	6.5* (5.3 to 7.4)	5.8* (3.0 to 7.0)	5.0* (3.0 to 6.0)
Self-reported "stiffness" (0 to 10 scale)	6.0 (3.0 to 7.0)	3.8* (3.0 to 6.0)	3.0* (2.0 to 6.0)	3.0* (1.0 to 4.8)
pD	15.0 (13.3 to 19.8)	13.0 (10.5 to 16.0)	10.5* (8.0 to 17.3)	9.5* (6.5 to 12.3)
VISA-A	28% (22% to 46%)	48%* (32% to 64%)	55%* (42% to 68%)	60%* (49% to 73%)
FAAM-ADL	57% (45% to 68%)	68%* (52% to 82%)	71%* (62% to 91%)	85%* (73% to 94%)
IPAQ: Self-reported minutes of vigorous activity per week	0 (0 to 146)	60 (0 to 240)	0 (0 to 135)	110 (0 to 293)
IPAQ: Self-reported minutes of moderate activity per week	15 (0 to 68)	80 (0 to 180)	90* (0 to 330)	60* (0 to 255)
IPAQ: Self-reported minutes of walking per week	300 (28 to 840)	360 (105 to 840)	390 (90 to 855)	390 (210 to 735)
IPAQ: Self-reported hours of sitting on a typical weekday	4.0 (3.1 to 6.6)	4.5 (3.0 to 8.0)	4.0 (3.0 to 6.0)	4.0 (3.0 to 8.0)
"Vital signs": Self-reported minutes of activity per week	58 (0 to 188)	160 (80 to 270)	100 (0 to 248)	65 (0 to 158)
EQ-5D-5L: Health	70% (52% to 86%)	70% (60% to 85%)	78% (70% to 80%)	85% (78% to 95%)
HADS: Anxiety subscale	5.0 (2.0 to 7.5)	4.0 (1.8 to 8.0)	5.0 (2.5 to 7.0)	3.0 (1.8 to 5.3)
HADS: Depression subscale	3.0 (1.5 to 7.0)	3.5 (1.8 to 4.3)	3.0 (1.5 to 4.0)	2.0 (1.0 to 3.0)

Abbreviations: EQ-5D-5L, EuroQol 5-dimensional questionnaire; FAAM-ADL, Foot and Ankle Ability Measure activities of daily living; HADS, Hospital Anxiety and Depression Scale; IPAQ, International Physical Activity Questionnaire; pD, painDETECT questionnaire; VISA-A, Victorian Institute of Sport Assessment–Achilles.
Data presented as median (interquartile range).
*Change from baseline reached statistical significance ($p < .05$), but absolute p values are not displayed for clarity.

Median values for self-reported "average pain" in subjects with noninsertional Achilles tendinopathy changed from 7.0 of 10 to 6.0 of 10 at 6 weeks ($p = .068$), to 6.0 of 10 at 3 months ($p = .075$), and to 6.0 of 10 at 6 months ($p = .109$). None of these differences in self-reported average pain reached statistical significance. Similarly, none of the changes in self-reported "worst pain" or "stiffness" reached statistical significance, except at 3 months, with a statistically significant improvement in "worst pain" from 9.0 at baseline to 8.0 at 3 months. In the remaining PROMs, the only value that reached a statistically significant difference was the VISA-A, improving from 24% at baseline to 44% at 3 months; however, it did not reach statistical significance at 6 weeks or 6 months, both at 3 months compared to baseline. The other marker of foot and ankle function, the FAAM-ADL, did not alter significantly at any time point studied for patients with noninsertional tendinopathy. Similar to those with insertional tendinopathy, the markers of global health (EQ-5D-5L), mental health functioning (HADS), and 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 noninsertional Achilles tendinopathy, with an asterisk indicating a statistical significant change ($p < .05$) from the baseline figures. Figures are displayed as median (IQR).

To compare effectiveness for patients with insertional versus noninsertional 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 the follow-up visits or from those who had not yet reached that particular time period postprocedure. Overall, no significant difference was seen in the changes in any of the parameters studied between subjects with either insertional or noninsertional Achilles tendinopathy. These figures are displayed in Table 5, with figures shown as median (IQR) and a positive value representing an improvement in each score at 3 months from the baseline levels.

In addition to the measures discussed previously, at each appointment, patients were asked to self-select the stages of the Roles and Maudsley score that best represented their current situation. This is a 1 to 4 categoric 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," and 4 = "My symptoms

Table 4
Displaying patient-reported outcome measures data for subjects with noninsertional Achilles tendinopathy at baseline and follow-up periods

Noninsertional Achilles Tendinopathy	Baseline (n = 9)	6 Weeks (n = 6)	3 Months (n = 9)	6 Mo (n = 4)
Self-reported "average pain" (0 to 10 scale)	7.0 (7.0 to 8.0)	6.0 (5.6 to 6.8)	6.0 (3.0 to 7.0)	6.0 (3.8 to 7.0)
Self-reported "worst pain" (0 to 10 scale)	9.0 (8.5 to 9.0)	7.0 (5.9 to 7.8)	8.0* (5.0 to 8.0)	8.5 (6.5 to 9.3)
Self-reported "stiffness" (0 to 10 scale)	7.0 (3.0 to 7.0)	5.0 (3.3 to 6.4)	6.0 (4.0 to 6.5)	3.0 (1.5 to 5.0)
pD	18.0 (13.0 to 20.0)	15.5 (12.8 to 16.0)	14.0 (5.0 to 19.0)	14.5 (9.8 to 17.5)
VISA-A	24% (20% to 29%)	38% (36% to 40%)	44%* (39% to 48%)	33% (26% to 46%)
FAAM-ADL	55% (44% to 59%)	56% (43% to 60%)	60% (48% to 76%)	71% (61% to 84%)
IPAQ: Self-reported minutes of vigorous activity per week	0 (0 to 30)	5 (0 to 115)	20 (0 to 36)	0 (0 to 5)
IPAQ: Self-reported minutes of moderate activity per week	0 (0 to 0)	5 (0 to 25)	12 (0 to 30)	0 (0 to 15)
IPAQ: Self-reported minutes of walking per week	75 (14 to 210)	15 (0 to 165)	60 (16 to 350)	220 (162 to 390)
IPAQ: Self-reported hours of sitting on a typical weekday	4.0 (4.0 to 7.0)	5.5 (2.8 to 6.0)	6.0 (4.0 to 8.0)	6.8 (5.3 to 8.0)
"Vital signs": Self-reported minutes of activity per week	10 (0 to 22)	14 (0 to 120)	30 (0 to 44)	20 (0 to 65)
EQ-5D-5L: Health	60% (52% to 75%)	73% (62% to 79%)	70% (50% to 78%)	60% (50% to 69%)
HADS: Anxiety subscale	7.0 (3.0 to 8.0)	6.0 (3.8 to 7.5)	7.0 (4.0 to 8.0)	7.5 (4.5 to 9.8)
HADS: Depression subscale	5.0 (3.0 to 9.0)	4.5 (0.5 to 8.5)	6.0 (3.0 to 7.0)	8.5 (4.5 to 11.8)

Abbreviations: EQ-5D-5L, EuroQol 5-dimensional questionnaire; FAAM-ADL, Foot and Ankle Ability Measure activities of daily living; HADS, Hospital Anxiety and Depression Scale; IPAQ, International Physical Activity Questionnaire; pD, painDETECT questionnaire; VISA-A, Victorian Institute of Sport Assessment–Achilles.
Data presented as median (interquartile range), unless otherwise noted.
*Change from baseline reached statistical significance ($p < .05$), but absolute values are not displayed for clarity.

Table 5
Displaying change in patient-rated reported outcome measures data for subjects with insertion and noninsertional Achilles tendinopathy from baseline to 3-month follow-up periods*

Change in Values From Baseline to 3 Months	Insertional Achilles Tendinopathy (n = 24)	Noninsertional Achilles Tendinopathy (n = 9)	*p* Value
Self-reported "average" pain (0 to 10 scale)	2.0 (1.0 to 3.3)	1.0 (0.0 to 4.0)	.437
Self-reported "worst" pain (0 to 10 scale)	2.0 (0.5 to 4.0)	1.0 (0.0 to 2.0)	.301
Self-reported "stiffness" (0 to 10 scale)	2.0 (−0.8 to 3.0)	1.0 (0.0 to 1.5)	.363
pD	4.0 (2.0 to 7.0)	1.5 (1.0 to 5.0)	.220
VISA-A	23% (0% to 43%)	11% (7% to 22%)	.617
FAAM-ADL	12% (1% to 27%)	12% (−7% to 23%)	.699

Abbreviations: FAAM-ADL: Foot and Ankle Ability Measure activities of daily living; pD, painDETECT questionnaire; VISA-A, Victorian Institute of Sport Assessment–Achilles.
Data presented as median (interquartile range).
* Positive figures indicate improvement, and negative figures indicate deterioration in condition. Significance figures calculate difference between the 2 groups.

Table 6
Displaying Roles and Maudsley score at each follow-up time point, comparing results for subjects with insertional and noninsertional Achilles tendinopathy

Roles and Maudsley Score	Insertional Achilles Tendinopathy	Noninsertional Achilles Tendinopathy	*p* Value
6 weeks	3.0 (2.0 to 3.0)	3.0 (2.3 to 3.0)	1.000
3 months	3.0 (2.0 to 3.0)	3.0 (2.0 to 4.0)	.359
6 months	2.0 (1.0 to 3.0)	3.5 (3.0 to 4.0)	.228

Data presented as median (interquartile range).

are no better, or worse than before the treatment." Overall, there were no significant differences at any of the time points in the Roles and Maudsley score between subject with insertional and noninsertional Achilles tendinopathy. These values are displayed in Table 6, with figures shown as median (IQR).

Discussion

Overall, beneficial results were obtained for patients with insertional and noninsertional Achilles tendinopathy following a combination of ESWT and a home rehabilitation. This study has been able to show improvements in a wide range of different PROMs. 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 ESWT, and this 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 article to directly compare between the groups of patients with noninsertional Achilles tendinopathy and with insertional Achilles tendinopathy, to explore any differences between outcomes from these 2 similar, but distinct, conditions. From the comparisons between patients with insertional Achilles tendinopathy and those with noninsertional Achilles tendinopathy, it was suggested that patients with insertional tendinopathy received greater benefits. 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.

Although pain is commonly reported as a barrier to physical activity in patients with Achilles tendinopathy, significant improvements in pain were demonstrated in patients with both noninsertional and insertional Achilles tendinopathy. No consistent benefits were recorded in the rates of physical activity undertaken. Further interventions may be required to specifically increase the rates of physical activity in this patient population. Owing 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 a small number of patients, particularly with noninsertional Achilles tendinopathy, who had traditionally undergone different treatments in the hospital department in which this study was based. The follow-up period of this study was relatively short, and a longer-term follow-up period 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, and following the procedure to see if pain is reduced using 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.

In conclusion, 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 noninsertional and insertional variants. Furthermore, it is hoped that further discussion can be made to harmonize the outcome measures used between different studies to give a more holistic view of patient functioning and to 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. 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 noninsertional Achilles tendinopathy.

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