Review Article

Astym® therapy: a systematic review

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Abstract: Soft tissue dysfunction can result from the degeneration of tissues as in the case of degenerative tendinopathy or from the build-up of problematic scar tissue, which can be the result of several aggravating factors, including overuse injuries, acute or chronic trauma, or as a result of surgery. This dysfunction often results in impaired movement, pain, and swelling of the affected area, which can lead to patient dissatisfaction and a lower quality of life. These soft tissue dysfunctions also have a marked economic impact. Although a number of traditional treatments attempt to address these issues, no optimal treatment choice has emerged. Traditional treatments are not always successful, can be invasive, and can consume many medical resources. A relatively new treatment approach, Astym therapy, is a potentially useful, non-invasive, more cost-effective option. This therapy was developed to address soft-tissue dysfunctions by stimulating the regeneration of soft tissues and the resorption of inappropriate scar tissue/fibrosis. It has been reported to help with the resorption and remodeling of abnormal tissue, thereby leading to improved motion, function and pain relief. The purpose of this analysis was to review the published literature related to Astym therapy on various musculoskeletal disorders. Specifically, we evaluated the effectiveness of this therapeutic method on disorders related to the: (I) knee; (II) upper extremity; (III) hamstring muscles; and (IV) ankle and Achilles tendon injuries.

Keywords: Soft tissue injuries; regeneration; regenerative therapy; tissue remodeling

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Introduction

Scar tissue formation around muscles, joints, tendons, and ligaments is often characterized by limited function, swelling, and pain (1). This abnormal tissue can form as a result of immobilization, overuse injuries, acute or chronic trauma, and other reasons (2-5); and can lead to chronic inflammation and tendinopathies (5-7). Additionally, scar tissue formation can occur after surgical procedures such as total knee arthroplasty and shoulder surgery, which can lead to stiffness and decreased motion (8-10). Regardless of the etiology, the pain and stiffness associated with these conditions can lead to patient dissatisfaction and a poor quality of life (11-13).

A number of traditional treatments are currently used to treat these problems, including oral non-steroidal anti-inflammatories, corticosteroid injections, cryotherapy or heat therapy, stretching, eccentric exercises, neuromuscular stimulation, and dynamic braces. If these treatments are unsuccessful, more invasive procedures such as manipulations or open surgery may be required (4,14,15).

In order to avoid surgery, less invasive treatments are being introduced (5,16,17). Astym® therapy (Performance Dynamics, Muncie, Indiana), is a relatively new noninvasive therapeutic approach that addresses soft-tissue dysfunction by relying in part on the use of cellular mediators and growth factors to assist in activating scar tissue resorption, stimulating tissue turnover and regenerating soft tissues. This therapy utilizes handheld instrumentation, applied topically, to locate underlying dysfunctional soft tissue and then transfer particular pressures and shear forces to the dysfunctional tissue through specific protocols and patterns developed from scientific and clinical study. The instrumentation is designed to assess the presence of dysfunctional tissue by amplifying the tactile sensation of the underlying texture of the soft tissues in order to provide the treating clinician with indications where rough or improperly organized tissue is located. Once an area of potential dysfunctional tissue is located, the clinician applies appropriate pressures and shear forces to that tissue to initiate a reparative cellular response in dysfunctional tissue (1,5,18,19). At the cellular level, Astym treatment has been shown to stimulate a regenerative response via stimulating the recruitment and activation of fibroblasts, which produce fibronectin, and thereby helps to facilitate soft tissue healing and remodeling (20-23). Although this therapy utilizes instruments topically, it is a distinctly different approach than Tooling/Scraping, which is also referred to as Instrument Assisted Soft Tissue Mobilization ("IASTM"). The methods and results are quite different from Astym therapy, and IASTM methods are often not well-tolerated by patients. IASTM methods use tooled cross friction massage to mechanically break apart the tissue, whereas, Astym therapy engages the regenerative mechanisms of the body aiming to repair damaged tissue and resorb scar tissue.

While randomized, controlled clinical trials and other clinical and scientific studies demonstrate the safety and effectiveness of Astym therapy on particular musculoskeletal disorders, there are no reports encompassing the gamut of the literature on this therapeutic intervention. Therefore, the purpose of this study was to review the published peer-reviewed results of Astym therapy on various parts of the body. Specifically, we evaluated the use of this therapeutic method on disorders of the: (I) knee; (II) upper extremity; (III) hamstrings muscles; and (IV) ankle and Achilles tendon injuries.

Methods

A literature search was performed using PubMed, EBSCO, and Scopus to identify all studies that were published from the inception of the database until April 2017. The search terminology that was used was "Astym", which yielded 12 reports. The reference lists of these reports were also reviewed to find additional studies. Due to the limited literature on this treatment, all of the studies were included, regardless of their design. There were 6 studies that evaluated the use of Astym therapy on the knee, 3 studies that evaluated its use on upper extremity conditions surgery, 1 study evaluated Astym therapy's use on the hamstring muscles, 3 studies evaluated use of Astym therapy for ankle or Achilles tendon injuries, and 1 study that evaluated its effect on for both hamstring and Achilles tendon pathology.

Results

Knee

Of the 6 studies that evaluated Astym therapy on the knee, 4 reported on patients after undergoing total knee arthroplasty, one randomized clinical trial evaluated lower extremity musculoskeletal injuries, and one randomized clinical trial reported on patellar tendinitis (*Table 1*). Chughtai *et al.* (18) evaluated 21 patients (26 knees) who underwent TKA followed by a standard physical therapy protocol and had at least one failed manipulation under anesthesia (MUA), and continued to have persistent knee stiffness. After undergoing treatment with Astym therapy for a mean of 17 sessions, there were improvements in flexion deficit (70° to 105°, $P \leq 0.001$), flexion contracture (15° to 3°, $P \leq 0.001$), and the Knee Society objective (57 to 80 points, $P<0.0001$) and function scores (54 to 80 points, $P=0.0003$). In another study (24), they evaluated 57 patients (57 knees) who had a mean age of 59 years (range, 32 to 81 years) who underwent TKA followed by MUA either underwent standard of care physical therapy (n=35) or innovative multimodal physical therapy (IMMPT), which included Astym therapy (n=22). At the 6-month evaluation, the IMMPT group did not have any repeat MUAs, but the standard of care group had 7 repeat MUAs ($P=0.025$), and the IMMPT group had better knee flexion compared to the standard of care group (116° *vs.* 106°, $P=0.005$). Similarly, McGinn *et al.* (26) reported on 127 non-obese patients (127 knees) who had a mean age of 67 years (range, 42 to 88 years) and underwent TKA and underwent standard of care physical therapy (n=80) or IMMPT, which included Astym therapy (n=47), and found that the average flexion (115° *vs.* 115°, $P=0.6$) and extension (0.83° *vs.* 0.81°, $P=0.9$) were similar, but the rate of MUA was much higher in the

Table 1 Astym therapy use on the knee

Study (author, year PMID)	Type of study	# of patients	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
Chughtai *et al.* 2016 (18)	Prospective	26 knees (21 patients) with recalcitrant knee stiffness after primary or revision TKA	Not available	Astym therapy	Passive and active ROM New Knee Society score	Prior to and after finishing the Astym therapy sessions, which was defined as having a ROM of <5 to 110º	Patients had a mean of 17 physical therapy sessions over a mean of 2 months; addressed: patellar tendon, patellar retinaculum, distal IT band, quadriceps muscle and tendon, hamstrings, gastrocsoleus complex, and Achilles tendon	Comparing mean preoperative and postoperative values: There was an improvement in flexion deficit (70° *vs.* 105º, P≤0.001); improvement in flexion contracture (15° *vs.* 3º, P≤0.001); improvement in KSS objective (57 *vs.* 80 points, P<0.0001) and function scores (54 *vs.* 80 points, P=0.0003)
Chughtai *et al.* 2016 (24)	Retrospective	57 knees (57 patients) who had TKA followed by MUA	35 (standard of care physical therapy)	22 [innovative multimodal physical therapy (IMMPT)] which included Astym therapy	ROM; rate of repeat MUA; time to repeat MUA	6 months from start of physical therapy	Standard of care: inpatient physical therapy for 1–3 days after TKA; outpatient physical therapy for 1–6 weeks postop; outpatient physical therapy at 4–8 weeks; innovative physical therapy: 30 minute sessions; Astym therapy: 4 weeks from start of physical therapy and 8–12 sessions or ROM >120º; CKD: 2–3 weeks for 30 min 3 times a day; OCSI brace: 4–6 weeks of physical therapy for at least 3 hours a day; NMES: from day 1 of physical therapy, 20 min twice a day; of note, various modalities were used based on flexion contracture, extension lag, and/or muscle weakness	The IMMPT group had no repeat MUA, whereas the control group had 7 (P=0.025); the IMMPT group had better flexion compared to the control group (116° *vs.* 106º, P=0.005)

Table 1 (*continued*)

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Study (author, year PMID)	Type of study	# of patients	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
Kivlan *et al.* 2015 (25)	RCT	45 patients with lower extremity musculoskeletal injury/pathology	15 control	15 sham therapy; 15 Astym therapy	Isometric squat strength	Before and after the intervention for 1 session	Baseline isometric squat strength measured; treatment performed for 12 minutes; strength measured again	Astym therapy group had a greater percent change in maximal force output compared to placebo (15% *vs.* −6%, P=0.0001) and compared to controls (15% *vs.* −1%, P=0.001); no difference seen between placebo *vs.* controls
McGinn *et al.* 2016 (26)	Retrospective	127 knees (non-obese patients) who underwent TKA	80 (standard physical therapy)	47 (IMMPT, which includes Astym therapy)	ROM; rate of MUA	Not available	Standard of care: inpatient physical therapy for 1–3 days after TKA; outpatient physical therapy for 1–6 weeks postop; outpatient physical therapy at 4–8 weeks; Innovative physical therapy: 30 minute sessions; Astym therapy: 4 weeks from start of physical therapy and 8–12 sessions or ROM >120º; CKD: 2–3 weeks for 30 min 3 times a day; OCSI brace: 4–6 weeks of physical therapy for at least 3 hours a day; NMES: from day 1 of physical therapy, 20 min twice a day	IMMPT group had a lower rate of MUA compared to the standard physical therapy group (1 *vs.* 10, P=0.045); IMMPT and standard physical therapy group had similar mean flexion (115º *vs.* 115º, P=0.6) and extension (0.81º *vs.* 0.83º, P=0.9)
Bhave *et al.* 2016 (27)	Case report	1 recalcitrant knee stiffness after TKA and MUA	N/A	Astym therapy	ROM; functional ability; pain; patellar tendon length	Not available	12 physical therapy visits: first 6 were 2 times per week for 3 weeks, then once per week for 6 weeks that included patellar mobilization, tibiofemoral mobilization. Astym therapy, and a custom knee device at home worn 8–12 hours per day	After 12 visits: Arc ROM improved from 5–110º to 5–115º; GROC score was +7; Pain improved from 10/10 to 2/10; radiographs showed resolution of patella baja, which demonstrated a 1 cm change in patellar position

Table 1 (*continued*)

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Study (author, year PMID)	Type of study	# of patients	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
Wilson *et al.* 2000 (28)	RCT	20 patients with patellar tendinopathy	10 standard of care	10 Astym therapy	Clinical data: self-reported questionnaires	0, 6, and 12 weeks	Not available	All 10 of the Astym therapy group had resolved pain, while only 60% in the standard of care group had resolved pain. Compared to the standard of care, Astym therapy improved pain and functional impairment (P=0.04)

GROC, global rating of change; LEFS, lower extremity functional scale.

standard physical therapy group compared to IMMPT (10 *vs.* 1, P=0.045). In a case report, Bhave *et al.* (27) reported on a 38-year-old male who underwent TKA and had persistent knee stiffness despite undergoing 2 MUAs. After 12 physical therapy visits where he received concomitant Astym therapy, the patient's knee flexion increased from 110° to 115°, his global rating of change score was +7, pain improved from a 10/10 to a 2/10, and radiographs showed the patella had a 1 cm change in position, which demonstrated his patella baja had resolved.

Kivlan *et al.* (25) performed a randomized clinical trial on 45 patients who had a mean age of 40 years (range, 18–65 years), who had a lower extremity musculoskeletal injury/pathology. They determined the change in isometric squat strength after either no therapy (n=15), sham Astym therapy (n=15), or Astym therapy (n=15). They found that the Astym group had a larger percent change in the output of maximal force as compared to sham Astym therapy (15 *vs.* −6 N, P=0.0001) and compared to the no therapy group (15 *vs.* −1 N, P=0.001); there was no difference between sham Astym therapy and the no therapy group. Wilson *et al.* (28) performed a randomized clinical trial that evaluated 20 patients with patellar tendinopathy, of which 10 patients received standard of care therapy and 10 received Astym therapy. They found all 10 of the Astym therapy patients had resolution of pain, whereas only 6 patients in the standard of care group had pain resolution. In addition, compared to the standard of care group, Astym treatment led to significantly better outcomes in subjective functional-impairment (P=0.04).

In summary, of the four studies that reported on patients who had persistent knee stiffness after TKA, even after undergoing at least 1 MUA, who were treated with Astym therapy and/or IMMPT, which included Astym treatment, had significantly better knee range-of-motion and Knee Society scores, and pain relief. Astym therapy also was associated with superior results with improved function and pain relief in those with patellar tendinitis, and an increased lower extremity isometric muscle strength, especially with injuries to the hip, thigh, and knee region compared to the more distal aspect of the lower extremity.

Upper extremity

There were two studies that evaluated Astym therapy on the shoulder and 1 study that evaluated the elbow (*Table 2*). Davies and Brockopp (29) performed a pilot study that evaluated patients who developed adhesions

Table 2 Astym therapy use on the upper extremity

Study (author, year PMID)	Type of study	No. of patients	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
Davies and Brockopp 2010 (29)	Retrospective	18 women who underwent mastectomies for breast cancer		Astym therapy	DASH score; abduction; flexion	Initial evaluation and discharge from physical therapy	At least 2 times a week for an average of 8.5 visits over a mean of 9 weeks, as well as home exercises to complete	Astym therapy significantly improved DASH score by 29 points (P<0.001), and shoulder abduction by 16° (P<0.001) and flexion by 13° (P<0.001)
Davies *et al.* 2016 (30)	Prospective	42 women, who underwent mastectomies for breast cancer	Not available	Astym therapy	DASH score; clothing questionnaire; PSFS; shoulder flexion; shoulder abduction	Initial evaluation and discharge from physical therapy	2 times a week with a minimum of 2 days between treatments for 8 treatments over 4 to 6 weeks	The DASH score improved from 33 to 23 points (P<0.01); the PSFS score improved from 5 to 7 points (P<0.01); clothing questionnaire improved from 19 to 15 points (P<0.01); shoulder flexion increased (135° vs 154°, P<0.01); shoulder abduction increased (135° *vs.* 154°, P<0.01)
Sevier *et al.* 2015 (31)	RCT	113 elbows (107 patients) with lateral elbow tendinopathy >12 weeks	56 eccentric exercises	57 astym therapy	DASH; pain with activity; max grip; function	Baseline, 4, 8, and 12 weeks, and 6 and 12 months	4 weeks; controls: stretching 3 times per day, eccentric strengthening performed 2 times per week for 2 sets of 15 reps; astym therapy: 2 times per week along with the same stretching and eccentric strengthening protocol as the controls	Resolution occurred in 78.3% in the Astym therapy group compared to 40.9% for the eccentric exercise group; compared to eccentric exercise group, Astym therapy group had better reductions in DASH scores (↓13.3 *vs.* ↓7.8 points, P=0.047) and better grip strength (↑9.4 *vs.* ↓1.9 lbs, P=0.008); control group recalcitrant to eccentric exercise after 8 weeks received Astym therapy: DASH improved (P<0.005); pain with activity decreased (P=0.002); function increased (P=0.004)

DASH, disabilities of the arm, shoulder, and hand outcome measure; PSFS, patient-specific functional scale.

Table 3 Astym therapy use on the hamstrings

Study (author, year PMID)	Type of study	No. of patients	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
McCormack *et al.* 2012 (5)	Case report	1 bilateral proximal hamstring tendinopathy	Not available	Astym therapy	LEFS; pain scale	Each visit	Physical therapy 2 times per week for 16 visits with eccentric hamstring strengthening and Astym therapy plus home exercise program	After the 16 visits, patient reported a 95% improvement
Scheer *et al.* 2016 (32)	Case report	1 patient with CP and Achilles tendinopathy and bilateral hamstrings stiffness	Not available	Astym therapy	ROM; satisfaction	Baseline and discharge from physical therapy	11 physical therapy sessions. Warm up, Astym therapy, then stretching exercises	Hamstrings flexibility increased from 140° to 165° with the hips in the 90/90 position

LEFS, lower extremity functional scale.

after undergoing mastectomy for breast cancer, and were treated with Astym therapy. They found that Astym treatment significantly improved the DASH score by 29 points (P<0.000), and shoulder abduction by 16º (P<0.000) and flexion by 13º (P<0.000). Additionally, the number of women who could tolerate wearing a bra after Astym therapy increased from 56% to 100%. In another study, Davies *et al.* (30) reported on 42 women who had a mean age of 52 years (range, 33 to 75 years) who had mastectomies performed for breast cancer. After undergoing 8 treatments, there were improvements in the DASH score (33 to 23 points, P<0.01), the Patient-Specific Functional Scale score (5 to 7 points; P<0.01), the clothing questionnaire score (19 to 15 points; P<0.01), shoulder flexion (135º to 154º, P<0.01), and shoulder abduction (135º to 154º, P<0.01).

Sevier *et al.* (31) performed a randomized controlled trial that evaluated 107 patients (113 elbows) with lateral elbow tendinopathy and were allocated to receive eccentric exercises (n=56) or Astym therapy plus exercises (n=57). After 4 weeks of therapy, the Astym group had resolution in 78.3% compared to 40.9% for the eccentric exercise group, and compared to the eccentric exercise group, the Astym group had significantly higher DASH scores (P=0.047), and better grip strength (P=0.008). Furthermore, the recalcitrant patients in the eccentric exercise group whose symptoms did not resolve with their initial treatment, after undergoing 8 treatments of Astym therapy, their DASH scores improved (P<0.005), pain with activity decreased (P=0.002), and function increased (P=0.004).

In summary, Astym therapy was beneficial to patients who developed soft tissue restrictions after undergoing mastectomies for breast cancer, by helping to decrease the disability related to the shoulder and also was associated with increased shoulder range-of-motion. Additionally, in patients with lateral elbow tendinopathy, Astym therapy was shown to be highly effective and safe not only as an initial treatment, but also as a treatment for recalcitrant cases. While this therapeutic intervention was successful in these musculoskeletal conditions, in order to determine the efficacy of Astym therapy on a wider range of upper extremity disorders, further study may be needed.

Hamstring muscles

There were 2 case reports that reported on Astym therapy for the hamstring muscles (*Table 3*). McCormack *et al.* (5) reported on a 44-year-old female who had proximal hamstring

tendinopathy characterized by pain with walking and sitting and was unable to run. She had physical therapy two times per week for 16 visits and received Astym therapy, and after 8 weeks, the patient was pain free with walking and sitting and was able to run pain free for more than 2 miles. Also, Scheer *et al.* (32) evaluated an 8-year-old female with a diagnosis of cerebral palsy who had bilateral hamstring stiffness, and after undergoing 11 physical therapy session with Astym therapy, the patients hamstring flexibility increased from 140° to 165° with the hips in the 90/90 position.

In summary, Astym therapy along with stretching and eccentric exercises led to marked improvements in hamstring tendinopathy and stiffness. Since the 2 studies reporting on these outcomes were both case reports, more studies are warranted in order to further confirm the benefits of Astym therapy for problems related to the hamstrings.

Ankle and achilles

There were 4 studies that reported on Astym therapy for treating ankle and Achilles tendon pathologies (*Table 4*). McCormack *et al.* (19) reported on a 53-year-old female who was diagnosed with tendinopathy of the mid-portion of the Achilles who underwent Astym therapy twice per week for 5 weeks, and after the 10th treatment the patient was pain free and was able to participate in her normal activities. Similarly, in a randomized controlled trial, McCormack *et al.* (1) evaluated 15 patients with insertional Achilles tendinopathy, with 8 patients allocated to receive eccentric exercise and the other 7 received Astym therapy in addition to eccentric exercises. At 12 weeks, more successful outcomes occurred in the Astym group compared to the eccentric exercise only group (100% *vs.* 50%, P=0.03), and this continued at the 26- (P<0.01) and 52-week (P<0.01) follow-ups. Also, while pain level significantly improved within the groups, there was no significant difference when the groups were compared.

In another study, Slaven *et al.* (33) described the case of a 35-year-old female who had a severe ankle sprain that required her to wear a walking boot for 3 weeks, and had the complaint of chronic ankle pain that allowed her to only run pain free for 4 minutes, and made descending stairs difficult. After receiving physical therapy along with Astym treatment over 5 visits, she was able to run for 40 minutes without pain and was able to descend stairs. In a case already described, by Scheer *et al.* (32), an 8-year-old female with cerebral palsy suffered from Achilles tendinopathy, and received 11 physical therapy sessions with Astym treatment. At discharge from the therapy, the patient's ankle dorsiflexion increased from –5° to 5° with the knee at 0° of flexion and increased from 0° to 5° with the knee at 90° of flexion.

In summary, Achilles tendinopathy and chronic ankle pain showed significant improvements after being treated with Astym therapy in addition to eccentric exercise. The patients showed successful outcomes at the 52-week follow-up (1). Patients also demonstrated improved ankle range-of-motion, decreased pain, and were able to resume their normal daily activities after receiving Astym therapy.

Conclusions

The present analysis reviews the use of Astym therapy for soft tissue disorders of the knee, upper extremity, hamstring muscle, Achilles tendon, and ankle. Astym therapy was developed methodically from theory through basic science investigation to clinical study and practice. Evidenced in laboratory studies to engage the regenerative mechanisms of the body, it has been shown to be a consistently safe and effective treatment in the conditions studied. Based on the results of the present review, the incorporation of Astym therapy into rehabilitation protocols, can lead to significantly better outcomes in terms of range-of-motion and function in patients with postoperative pain and stiffness due to soft-tissue fibrosis, as well as patients who are suffering from other soft-tissue disorders such as tendinopathy. Due to the fact that some of these studies were case reports, larger studies will be needed in order to confirm the benefits of Astym therapy on a variety of musculoskeletal disorders.

Table 4 Astym therapy use on the ankle/Achilles tendon

Study (author, year PMID)	Type of study	# of pts	Modality (N)		Parameters assessed (pain, swelling, ambulation, etc.)—list them	Timing of evaluations	Protocol of administration	Salient finding for each parameter assessed
			Control	Study				
McCormack *et al.* 2016 (1)	RCT	15 with Achilles tendinopathy	8 eccentric exercise only	7 eccentric exercise + Astym therapy	VISA-A questionnaire; NPRS; GROC	Baseline, 4, 8, 12, 26, and 52 weeks	12-week period—3 sets of 15 reps per session and 2 sessions per day or Astym therapy 2 times a week for 6 weeks	Astym group had greater improvements on VISA-A at 12- (82 *vs.* 52 points, P<0.01), 26- (86 *vs.* 55 points), and 52-week (91 *vs.* 67 points, P<0.01) follow-up; at 12-weeks, the Astym group had more patients achieve successful outcomes compared to the eccentric exercise only (100% *vs.* 50%, P=0.03)
McCormack *et al.* 2012 (19)	Case report	1 patient with mid-portion Achilles tendinopathy	Not available	Eccentric exercise and Astym therapy	LEFS; NPRS	4th, 6th and 10th visits	PT 2 times per week with 10 visits over a 5-week period; Astym treatment; plus home exercise program	LEFS improved from 70 to 79 points; NPRS score improved from 8/10 to 0/10
Scheer *et al.* 2016 (32)	Case report	1 patient with CP and Achilles tendinopathy and B/L hamstrings stiffness	Not available	Astym therapy	ROM; satisfaction	Baseline and discharge from physical therapy	11 physical therapy sessions. Warm up, Astym therapy, then stretching exercises	Ankle dorsiflexion at 0° of knee flexion increased from –5° to 5°, and at 90° increased from 0° to 5°
Slaven *et al.* 2011 (33)	Case report	1 patient with chronic ankle pain s/p ankle sprain	Not available	Astym therapy	Subjective; GROC; PAIN; LEFS	At each visit, then at 3 months	5 physical therapy visits; joint mobilization, manipulation, and Astym therapy	Prior to physical therapy, patient had difficulty descending stairs and could only run for 4 minutes until pain started. After the 5 weeks, patient was able to descend stairs and run for 40 minutes without pain; from visit 1 to 3 month follow-up: GROC: NA to 7, pain: 1 to 0, LEFS: 61 to 80

VISA-A, Victorian Institute of Sport Assessment Achilles-Specific Questionnaire; NPRS, numeric pain rating scale; GROC, global rating of change; LEFS, lower extremity functional scale.

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Footnote

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