Case Report

The management of bilateral high hamstring tendinopathy with ASTYM[®] treatment and eccentric exercise: a case report

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High hamstring tendinopathy (HHT) is an overuse injury that occurs most commonly in runners. The management of HHT is often challenging and the research supporting many interventions is limited. Eccentric exercise has been proven effective in the treatment of various tendinopathies but has not been thoroughly studied with HHT. Soft tissue mobilization, including ASTYM, is often utilized in the treatment of tendinopathies, though there is limited evidence supporting this approach. The purpose of this paper is to present the case of a patient referred to physical therapy with bilateral HHT. The patient was a 41-year-old recreational runner that had an insidious onset of right buttock pain 12 months prior to initiating therapy and left buttock pain 9 months prior. Her primary complaints included an inability to run, pain with prolonged or brisk walking, and pain with sitting on hard surfaces. The patient was treated in physical therapy two times per week for 16 visits with treatment focused on eccentric hamstring strengthening and ASTYM. By her eighth visit, the patient was able to walk 2.5 miles without pain and by her 12 visit, she was able to jog 1 mile before the onset of pain. After 16 visits, the patient reported that she was approximately 95% improved, was able to run 2.5 miles without pain, and had no pain with sitting on hard surfaces. This case suggests that eccentric exercise combined with ASTYM may be an effective treatment for HHT.

Keywords: ASTYM, Eccentric exercise, Manual therapy, Tendinopathy, Hamstring

Background

High hamstring tendinopathy (HHT) is an overuse injury that occurs most commonly in distance runners.¹ Symptoms included deep gluteal region pain that is aggravated by running or brisk walking. In severe cases, symptoms may also be aggravated by sitting on hard surfaces.¹ Limited information is available on the diagnosis and treatment of HHTs but histologic studies have shown dense fibrosis at the hamstring attachment to the ischial tuberosity.^{1,2} Running is thought to place the hamstrings at risk for injury because of the large amount of time that the muscle group spends under maximal stretch and because of repetitive eccentric loading into this position.^{1,3}

Eccentric strength training has shown promise as an effective treatment for many types of tendinopathies.^{1,3-8} Various mechanisms have been proposed to describe the effects of eccentric exercise on tendon healing. It has been suggested that eccentric exercises work by promoting collagen fiber

cross-linkage within the tendon to allow remodeling to occur.⁹ This was supported by Langberg *et al.* who found that type I collagen synthesis rate increased in subjects with Achilles tendinopathy following completion of a 12-week eccentric exercise program.¹⁰ Neovascularity and associated neural ingrowth have been found to occur with painful Achilles tendinopathy,¹¹ and the destruction of these new growths has been proposed to lead to pain relief.^{12,13}

The literature on eccentrics for hamstring tendinopathy, especially HHT, is limited.^{1,14} Eccentric hamstring weakness has been associated with an increased risk for injury and eccentric training has been shown to reduce the chance of re-injury.^{1,15-17} There is less research available on the effects of eccentric hamstring training for reducing pain and allowing athletes to return to sport. A case study reported that an 8-month eccentric-based rehabilitation program was effective at allowing a football player with chronic-recurrent hamstring strains to return to sport.¹⁸ Based on available research, it appears that eccentric training has the potential to be beneficial in the treatment of HHT but this has not been thoroughly studied.

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Soft tissue mobilization has been proposed to help normalize tendon structure and is a recommended treatment in the management of tendinopathies, though there is limited evidence supporting this approach.^{1,17} ASTYM® (Performance Dynamics, Muncie, IN, USA) is a non-invasive soft tissue therapy in which a specific treatment process uses handheld instrumentation to topically locate underlying dysfunctional soft tissue and then transfer pressure and appropriate shear forces to that tissue.¹⁹ The treatment includes specific protocols and instruments used to stimulate affected soft tissues to heal and regenerate at a cellular level.²⁰ ASTYM has been shown to cause increased fibroblast recruitment and activation in rat tendons which should theoretically promote proper healing, but this has not been thoroughly studied in humans.^{21–23} ASTYM treatment is thought to activate a regenerative response in soft tissues via induction of leakage from dysfunctional capillaries which leads to fibroblast activation, macrophage mediated phagocytosis, and a local release of growth factors.^{20–24}

While eccentric exercise and ASTYM should theoretically be useful in the management of HHT, the research supporting both of these interventions is lacking and there are no studies that have reported the effects of a combined treatment approach. Therefore, the purpose of this report was to present the management and outcomes of a patient with bilateral HHT who was treated with eccentric exercise and ASTYM.

Case Description

Patient characteristics

The patient was a 41-year-old female elementary school teacher referred to physical therapy with a diagnosis of bilateral HHT. She was also a recreational runner who typically completed 3-mile runs up to 5 days per week prior to becoming symptomatic. The patient experienced an insidious onset of right buttock pain approximately 12 months prior but was able to continue running at a reduced volume and intensity. Approximately 3 months later, she developed left buttock pain along with worsening right buttock pain and was unable to continue running. Previous treatment included non-steroidal anti-inflammatory medication as well as prednisone which the patient reports did not help. She was also seen in physical therapy at a different facility for treatment that included hamstring stretching, general lower extremity strengthening, and therapeutic ultrasound. The patient reported that therapy was discharged after approximately six visits secondary to a lack of improvement. According to the medical record, there were no significant findings on radiographs of her hips and spine.

Examination

During her initial physical therapy evaluation, the patient reported buttocks pain over the ischial tuberosity bilaterally. She reported that her pain levels fluctuated from 0/10 at best to 6/10 at worst on the numeric pain rating scale during the previous 48 hours. Her primary complaints also included an inability to run, pain with prolonged or brisk walking, pain with car transfers, and pain with sitting on hard surfaces. She also reported pain with pulling her shoe off with the other foot. This movement has been described as the ‘taking off the shoe test’ with a reported specificity of 100% for hamstring injury.²⁴ Her goals for therapy were to have decreased pain and to be able to return to running.

At the initial evaluation, the patient completed the lower extremity functional scale (LEFS) and scored a 64/80. The LEFS is a self-report questionnaire used to assess the function of patients with lower extremity orthopedic conditions.²⁵ It consists of 20 items, each with a maximum score of 4. The maximum total score is 80 and higher scores indicate higher level of function. Construct validity has been demonstrated with a good correlation between the LEFS and the SF-36 physical function subscale ($r=0.80$) and a moderate correlation with the SF-36 physical component score ($r=0.64$). Excellent test-retest reliability was also reported ($R=0.94$).²⁶ Her medical history was reviewed and was deemed to be non-significant. There was no history of previous lumbosacral or lower extremity injuries reported. Physical examination was completed to test the lumbosacral spine, bilateral hips/knees, and lower extremity musculature. The patient demonstrated full pain-free lumbar spine range of motion with overpressure in all directions. However, lumbar spine flexion in standing with her knees extended did reproduce buttocks pain. There was no change in symptoms after 10 repetitions of repeated lumbar flexion and 10 repetitions of repeated lumbar extension.²⁵ Sacroiliac joint provocation testing was performed as described by Laslett²⁷ and all five tests were deemed to be negative. Central and unilateral posterior to anterior mobilizations were performed over the lumbosacral spine as described by Fritz *et al.*,²⁸ and mobility was judged to be normal and pain-free. Straight leg raise tests, straight leg tests with dorsiflexion,²⁹ and slump tests were negative bilaterally. A palpatory examination of the lumbosacral spine was negative for tenderness.

Testing of the hip and knee joints revealed normal range of motion without pain and the hip scour test was negative. The strength of her bilateral hip flexors, hip abductors, hip external rotators, and knee extensors were judged to be 5/5 with manual muscle testing³⁰ and were pain-free. Hip extension was judged to be 4/5 bilaterally with slight pain

reproduction and knee flexion was 4–/5 with significant pain bilaterally. She was tender to palpation over the ischial tuberosity and proximal 2 inches of the hamstrings bilaterally. Hamstring flexibility was testing in supine with the patient's hip maintained in 90° of flexion while her knee was passively extended.³¹ This testing reproduced pain over the ischial tuberosity bilaterally and was judged to be abnormal. Flexibility testing of the quadriceps, hip flexors, and lateral thigh was judged to be normal bilaterally.³¹

Clinical impression

The patient's chief complaint and examination findings were consistent with clinical characteristics suggestive of HHT. The patient presented with tenderness to palpation over the ischial tuberosity and proximal hamstrings. Her symptoms were also reproduced with manual muscle testing and stretching of the hamstrings. The examination was negative for lumbar, sacroiliac, and hip joint involvement and these conditions were ruled out. ASTYM and eccentric training were selected for treatment based on a review of the current literature and theories on tendinopathies.^{1–23}

Intervention/outcomes

The patient was treated in physical therapy two times per week for a total of 16 visits. The treatment provided at each session is summarized in Table 1. After the initial evaluation, ASTYM treatment was initiated per the described protocol²³ and the patient was instructed in a home exercise program (HEP). The HEP included prone hamstring curls using a resistance band around the ankle and the patient was instructed to focus on the eccentric part of the contraction. The patient was unable to perform the 'Nordic' hamstring exercise previously described¹⁶ secondary to pain and weakness, so this was not included in her initial HEP. The 'Nordic' hamstring exercise is a partner exercise where the subject attempts to resist a forward-falling motion using his hamstrings to maximize loading in the eccentric phase.¹⁶ The HEP also included a supine hamstring

Figure 1 ASTYM treatment. Image used with permission from Performance Dynamics, Inc.

stretching exercise. Follow-up clinic visits included ASTYM and a strengthening program with an emphasis on eccentric hamstring exercises (Table 1).

ASTYM treatment involves using specially designed instruments in a stroking motion along the skin while using a lubricant, such as cocoa butter, to reduce the coefficient of friction.^{23,32} The instruments are primarily moved along the direction of the underlying musculoskeletal structures but multidirectional strokes are also used around boney areas. During each treatment session, a progression of instruments with decreasing areas of surface contact is used.^{23,32} Each session of ASTYM for this patient lasted approximately 15–20 minutes and followed the protocol described in the ASTYM clinical manual.²³ Treatment to the hamstring muscles was performed with the patient in prone and in modified-prone with the involved limb hanging over the edge of the treatment table to allow better access to the proximal muscle insertion (Fig. 1). The treatment can be uncomfortable for some patients but is generally well tolerated. In the case of this patient, no adverse effects were noted.

The patient made consistent progress throughout the course of therapy (Table 2). After the third visit, the patient reported that she no longer had pain when

Table 1 Summary of treatment performed

Visit(s)	Intervention
1	Initial evaluation, ASTYM, HEP consisting of: prone hamstring curls with eccentric emphasis using resistance band (3 × 10 per session, two times/day), supine hamstring stretch (2 × 30 seconds per session, two times/day)
2–4	Warm-up on bike, ASTYM, HEP review, prone hamstring curl machine with emphasis on eccentrics (lift with two legs, lower with one leg), resisted hip extension, open chain quadriceps strengthening, contract relax hamstring stretching
5–8	Warm-up on bike, ASTYM, prone hamstring curl machine as above, seated hamstring curls from 0 to 90°, closed chain stool scoot hamstring exercise, contract relax hamstring stretching
8–12	As above with addition of unilateral bridging, and standing eccentric hamstring exercise (good morning exercise), good morning exercise was added to HEP at visit 11
13–16	As above with addition of lunges, single leg squat, lunge walks, and Nordic exercise. HEP was updated at the final visit and included prone hamstring curl machine, Nordic exercise, resisted hip extension, and lunges.

Notes: Abbreviation: HEP, home exercise program.

All strengthening exercises in the clinic were performed for 2–3 sets of 10 repetitions.

pulling her shoes off via a hamstring contraction. By her eighth visit, she was able to walk 2.5 miles and work without pain. A re-assessment was completed at her twelfth visit and the patient reported that she was 80% improved on the left and 90% improved on the right. At this point, she was able to jog 1 mile before the onset of low level pain and she reported less difficulty sitting on hard surfaces. Based on her current response to treatment, we elected to continue therapy two times per week.

After two more weeks of therapy (Table 1), the patient was re-assessed and discharged with an HEP. At this final visit, she reported being 95% improved overall and that she was able to run up to 2.5 miles without limitation from pain. She rated her pain as 2/10 at worst on the numeric pain rating scale during the previous 48 hours and stated that she was pain-free the majority of the time. Her final LEFS score was 74/80 which represents a 10-point improvement and is greater than the reported minimum clinically important difference of 9 points.²⁶ Her knee flexion strength was judged to be 5/5 on the right and 4+/5 on the left and both were pain-free. Her hip extension strength was 5/5 and pain-free bilaterally. The importance of continuing with her HEP was emphasized and she was instructed to contact the clinic with problems.

Discussion

HHT is a painful condition that is often challenging to medically manage.¹ While eccentric exercise has been thoroughly studied with other tendinopathies, the research for hamstring tendinopathy is limited.^{1,14} ASTYM has also been proposed as a treatment for tendinopathy and it is thought to work by stimulating the patient's body to normalize tissue structure following an increase in fibroblast recruitment and activation.²³

This case suggests that eccentric exercise combined with ASTYM may be an effective treatment for HHT. The patient in this case had long standing bilateral tendinopathy and had failed to respond to other treatments including a previous round of physical therapy. After 8 weeks of treatment (16 visits) with eccentric exercise and ASTYM, the patient

reported a 95% improvement in symptoms and was able to return to her normal running routine without limitation from pain. This treatment duration was notably shorter than the 12-week eccentric programs commonly reported for other tendinopathies.^{4,5}

This report presents the management and outcomes of a patient with bilateral recalcitrant HHT that responded well to a combined treatment of ASTYM and eccentric strengthening. Being a case report, it is impossible to draw conclusion about the relative contribution of each component of treatment. Also, as with all case reports, a cause and effect relationship cannot be inferred and the results cannot be generalized to other patients. However, the results of this case could provide a foundation for future research. Additional controlled studies are needed to compare the effects ASTYM to eccentric training individually as well as the effects of combined treatment.

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Table 2 Key improvements noted

Visit	Notable improvements
3	No pain with TOST
8	2.5-mile-walk without pain
12	80–90% subjective improvement 1-mile jog without pain
16	95% subjective improvement 2.5-mile run without pain LEFS improved to 74/80 (64/80 initial, MCID=9 points)

Note: Abbreviations: TOST, taking off shoe test; LEFS, lower extremity functional scale; MCID, minimum clinically important difference.

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