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Treatment of proximal hamstring tendinopathy with active release technique in collegiate track athletes: A case series

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TREATMENT OF PROXIMAL HAMSTRING TENDINOPATHY WITH ACTIVE RELEASE TECHNIQUE IN COLLEGIATE TRACK ATHLETES: A CASE SERIES

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Introduction

It is imperative that healthcare professionals implement evidence-based practice into their professional practice to provide the best patient-centered care. Evidence-based practice is a systematic approach to making decisions about patient care that includes patients' preferences and values, clinical expertise acquired through clinical experience and practice, and relevant research evidence in making decisions about patient care. A common challenging condition for clinicians to treat is a chronic injury. Proximal hamstring tendinopathy (PHT) is a common chronic condition among running athletes that is often characterized by pain in the upper hamstring or buttocks during repetitive activities. Proximal hamstring tendinopathy is typically treated non-operatively and includes activity modifications, pain modulating modalities, rehabilitative exercises to increase flexibility and strength, and corticosteroid or plasma rich protein injections. Active release technique (ART) has emerged as a manual therapy technique for improving pain and dysfunction associated with chronic, overuse conditions, including tendinopathies. Therefore, a theoretical basis exists to support the use of ART in the treatment of PHT, but patient outcomes have not been investigated. The purpose of this study is to describe pain and functional outcomes of three patients with PHT treated with ART.

Research Questions

1. Does ART reduce pain associated with PHT?
2. Does ART improve function in individuals with PHT?

Review of Literature

Evidence-Based Practice

Following evidence based practice (EBP) guidelines ensures that clinicians are providing care to patients that is holistic and supported by clinically researched evidence. The three components of the EBP paradigm include best available research evidence, patient values, and clinical expertise (Geisler et al., 2017). Clinicians can use these guidelines when deciding on the course of treatment for a particular patient. There are many forms of research studies available for healthcare professionals to refer to. An example of one of these studies is a case series. A case series, as defined by Murad et al. (2018), reports the clinical progress of multiple individual cases in a certain population which can include particular exposures, symptoms, signs, interventions, or outcomes. Clinicians may use a case series to obtain a preliminary understanding of certain treatment interventions.

When deciding which treatment option is best for a particular patient, it is important for clinicians to base this decision on current research. Houglum (2016) explained that the research used should demonstrate good quality questions, design, methods, and outcomes. It is up to the clinician to critically appraise each source of evidence, since not all published research meets high quality standards. For this reason, it is imperative for clinicians to compare multiple studies on a certain topic, in order to get a comprehensive and reliable understanding of the subject. When comparing these studies, clinicians should be a critical reader by asking themselves questions such as why studies on a certain topic differ, the differences in methods, differences of populations studied, the quality of variable control, and how each study analyzed their data (Houglum, 2016). Critically analyzing current research also helps clinicians stay up to date on new evidence related to their practice.

While assessing the available research is an important aspect of EBP, there may be limited evidence supporting common treatment options for musculoskeletal and orthopedic injuries. Therefore, clinician expertise is essential to EBP. Practicing clinicians are consistently acquiring and analyzing information about the interventions they are employing and the related outcomes. It is important for experienced clinicians to share their experience when deciding the best course of action to take with a particular patient and especially to younger, less experienced clinicians (Houglum, 2016).

The last component of the EBP paradigm is patient values. When providing patient-centered care, it is essential to include the patient's opinions and goals into the treatment plan. Doing this allows the patient to take an active role in their recovery, which may enhance their motivation and overall trust in their clinician. One way that patient values can be implemented into the treatment plan is through patient reported outcome measures (PROM). Houglum (2016) describes a PROM as a validated questionnaire that can be used to recognize patients' needs, goals, and desires and is administered before treatment begins, during the course of treatment, and then again once treatment has concluded. The use of PROMs allows clinicians to properly track patients' progress as well as check in on patients' wants and needs during their rehabilitation.

Chronic Injury

A chronic injury is defined as an injury that has an insidious onset and is a result of both intrinsic and extrinsic factors (Maffulli et al., 2004). Examples of intrinsic factors include muscle dysfunction, body weight, height, gender, and age, while extrinsic factors involve issues such as repetitive stresses from exercise, poor footwear, and poor training surfaces (Maffulli et al., 2004). The insidious onset and combination of intrinsic and extrinsic factors pose a challenge for

clinicians in diagnosing and treating patients with chronic injuries. Because of the insidious onset of chronic injuries, chronic injuries are often difficult to recognize before the injury progresses. Due to the effects from various intrinsic and extrinsic factors over time, the dysfunction in the affected area is well ingrained. This means that rehabilitating a patient with a chronic disorder may take more time and effort. An example of a chronic injury that can pose a challenge for treating clinicians is a tendinopathy.

Tendinopathy

A tendon plays a large part in supporting and transmitting forces between muscles and bones (Franco et al., 2019). Due to these factors, the tendon is prone to threatening situations that can lead to dysfunction and injury (Franco et al., 2019). Repetitive stresses overtime or tendon degeneration due to age are examples of common factors that can lead to dysfunction (Lempainen, 2015). Dysfunction in a tendon is defined as a tendinopathy. Repetitive stresses that are placed on a tendon may cause the tendon sheath to become inflamed and the body of the tendon to deteriorate (Maffulli et al., 2004). A typical treatment regimen for uncomplicated cases of tendinopathies involve icing and resting the affected area in the beginning stages of healing, stopping or decreasing physical activities that irritate the injury, soft tissue mobilizations, nonsteroidal anti-inflammatory drugs (NSAIDs), exercises that focus on eccentric strengthening of the affected tendon, and core stabilization exercises (Maffulli et al., 2004). However, in more complicated cases where the injury is more severe or the patient does not respond to treatment well, choosing treatment options can pose a larger challenge for clinicians. This is due to the fact that the current research available on the treatment of tendinopathies indicates that further evidence on the effectiveness of the various suggested treatments is necessary, making it difficult for clinicians to choose which intervention is most effective.

Proximal Hamstring Tendinopathy

One specific tendinopathy that has proven challenging for clinicians to manage is PHT. Hamstring tendinopathies are common in activities that involve quick and abrupt movements of the lower extremities, such as sprinting and jumping. Hamstrings also are commonly injured because they are structurally located from the hip to the knee. Therefore, rapid muscle lengthening commonly occurs with the combination of knee extension and hip flexion, which makes the muscle more susceptible to injury (Degen, 2019). This occurs commonly in activities such as running or sprinting. Typically, PHT is diagnosed by a thorough physical examination and diagnostic imaging such as musculoskeletal ultrasound or magnetic resonance imaging (Beatty et al., 2017). Proximal hamstring tendinopathy occurs at either the conjoint tendon of the biceps femoris and the semitendinosus, which attaches to the medial facet of the ischial tuberosity, or the semimembranosus tendon, which attaches to the lateral facet of the ischial tuberosity (Beatty et al., 2017).

Common Proximal Hamstring Tendinopathy Interventions

A variety of intervention strategies have been investigated for treating PHT. Corticosteroid injections serve as one intervention to temporarily treat pain associated with tendinopathies, but extended use can lead to deterioration of the tendon which could lead to rupture (Franco et al., 2019). Yet, clinicians are mostly concerned with long term effectiveness and promoting healing and recovery, so alternative treatments are often used. Another treatment option that has demonstrated to be effective in aiding in the healing of hamstring tendinopathies is electrical muscle stimulation (White, 2011). Shock wave therapy has also shown to be beneficial, but the studies performed using shock wave therapy have been of low methodological quality. This means there were errors and biases in the studies making the results of these studies

less valid (Franco et al., 2019). The goal of both electrical stimulation and shock wave therapy is to help reduce pain caused by hamstring tendinopathy.

One of the most researched treatment options for hamstring tendinopathies are muscle strengthening exercises. However, the current available evidence offers differing doses of muscle contraction and intensity. These conflicting treatment parameters furthers the difficulty of a clinician's treatment decisions (Franco et al., 2019). Of these muscular strengthening exercises, eccentric exercises seem to be the most commonly used. Eccentric strengthening involves a muscle being lengthened at the same time as it is contracting. Another intervention commonly used is soft tissue mobilization. This is usually used in conjunction with a different form of treatment. One study in particular involved the treatment of hamstring tendinopathy by using soft tissue mobilization with eccentric strengthening exercises (McCormack, 2012). In this study, a patient was seen for sixteen visits and Astym was used as the soft tissue mobilization tool (McCormack, 2012). By the end of treatment, the patient reported feeling 95% improvement and was able to run two to five miles without pain. These findings demonstrate that soft tissue mobilization used in combination with eccentric strengthening exercises may be effective in treating hamstring tendinopathy (McCormack, 2012). Another study also showed that soft tissue mobilization, lumbopelvic manipulation, and electrical muscle stimulation used together were effective in treating three different cases of hamstring tendinopathy (White, 2011). These studies all provide evidence on the effectiveness of different treatment options used during the conservative treatment of PHT.

Although conservative treatment is usually chosen to treat PHT, surgical treatment is also an option. Typically, surgical treatment is warranted if no improvement is seen with conservative treatment. The surgical technique used to treatment hamstring tendinopathy is called tenotomy,

which involves cutting of the tendon in order to help lengthen it and then suturing it to the neighboring hamstring tendon (Lempainen et al., 2009). One study demonstrated that surgical treatment of PHT in athletes successfully led to return to sport and relief of symptoms that was maintained at the follow up appointment, which occurred, on average, about 71.3 months later (Benazzo et al., 2013). This study suggests that surgical treatment may be effective at relieving pain and symptoms in the long term.

Active Release Technique

A proposed conservative treatment for tendinopathies is ART. Developed by Dr. Micheal Leahy, ART involves breaking down adhesions and scar tissue which cause pain and dysfunctions (Tak et al., 2013). ART involves a clinician using their thumbs or fingers to apply deep tension to a trigger point while the involved tissue is moved from a shortened to lengthened position both actively by the patient and passively by the clinician (Miners & Bougie, 2011). Previous research studies have investigated the use of ART for treating conditions such as chronic neck pain, low back pain with gluteus medius involvement, Achilles tendinopathy, carpal tunnel syndrome, adductor strains, and its effects on increasing hamstring flexibility (George, Tepe et al., 2006; George, Tunstall et al., 2006; Kim et al., 2015; Miners & Bougie, 2011; Robb & Pajaczkowski, 2011; Tak et al., 2013). All studies investigated the effectiveness of ART for treating pain and dysfunction and indicated the need for further research.

Effects of ART on Various Injuries

Robb and Pajaczkowski (2011) examined the effectiveness of ART in reducing short term pain following an adductor strain. ART was applied to hockey players who had sustained adductor strains, and Pain Pressure Threshold (PPT) was used to measure the patients' pain outcomes (Robb & Pajaczkowski, 2011). This study demonstrated that ART was beneficial in

reducing patients' pain. Similarly, a study that investigated the effectiveness of ART on chronic neck pain reported that ART was successful at breaking down adhesions in soft tissue that cause pain and dysfunction that contributes to chronic neck pain (Kim et al., 2015).

Another study investigated using ART on the gluteus medius in order to reduce low back pain (Tak et al., 2013). This study used PPT and the Visual Analog Scale (VAS) to show that ART decreased patients' low back pain after three weeks of treatment (Tak et al., 2013). Twelve participants with chronic low back pain were included in this study with participants receiving ART treatment twice a week for three weeks. Tak et al. (2013) found that back pain, measured by the VAS and PPT, was decreased after ART treatment.

One study also showed that ART was effective at decreasing patients' symptom severity and dysfunction caused by carpal tunnel syndrome (George et al., 2006). This study involved five participants suffering from carpal tunnel syndrome receiving ART as treatment three times a week for two weeks. Instruments used to measure the effects of this study were the Boston Questionnaire, used to evaluate carpal tunnel syndrome, and electromyography. These were used as baseline measurements before the initial treatment and at the end of the two-week treatment period.

Miners and Bougie (2011) demonstrated that a treatment involving active and passive warm-up, ART and Graston Technique, eccentric strengthening exercise, and calf stretching used with cryotherapy was able to more quickly resolve one particular case of Achilles tendinopathy as compared to a more traditional treatment approach. This case study involved a 40-year-old male who had experienced bilateral Achilles tendinopathy for 3.5 years. The participant received nine total treatments over an eight-week period. Each treatment began with active and passive heating of the Achilles by placing a hot pack on the Achilles while the patient rode a stationary

bike. The warmup was followed by Graston technique and ART. Finally, the patient performed eccentric calf exercises and stretched the gastrocnemius and soleus.

Lastly, one study demonstrated the effectiveness of ART at increasing hamstring flexibility (George et al., 2006). This study involved 20 male patients who received ART to their hamstrings and dorsal sacral ligament. Hamstring flexibility was measured by the sit-and-reach test before the application of ART and was then measured again after the treatment had finished. George et al. (2006) found that ART increased hamstring flexibility after one treatment.

Significance of Study

The literature presented demonstrates current treatment options that have been investigated to treat PHT and the effects ART has on various injuries, including some tendinopathies. However, research has yet to specifically investigate the effects of ART on pain and dysfunction caused by PHT. Since ART has shown to positively affect other chronic injuries presented in this review, it is worth investigating patient outcomes of patients with PHT that are treated with ART. Thus, the purpose of this study was to describe pain and functional outcomes of three patients with PHT treated with ART.

Methods

Research Design

A case series was used to describe pain and functional outcomes of three patients with PHT that were treated with ART. During the study, pre and post testing were performed to determine each patient's progress. Approval from the Institutional Review Board was obtained before the study began.

Participants

Participants that were recruited to participate included student-athletes from the track and field team at the University of Northern Iowa that presented with PHT that was confirmed by a certified athletic trainer after a physical examination and were to receive ART. Three participants were recruited, and all three met the inclusion criteria for this study.

Inclusion/Exclusion Criteria

The inclusion criteria determining whether a participant could take part in this study included: 1) receiving ART for PHT; 2) and confirmed hamstring tendinopathy by using diagnostic criteria as defined by Cacchio et al. (2012) by means of a positive Puranen-Orava test, a positive bent knee stretch test, and a positive modified bent knee stretch test. The exclusion criteria included: 1) participants presenting with any contraindications to ART such as acute injury, blunt trauma, or skin disorder; 2) unable to physically tolerate ART; 3) or a history of tendon rupture or other musculoskeletal injury on the involved limb.

Outcome Instruments

Numeric Pain Rating Scale. The Numeric Pain Rating Scale (NPR) is used to measure the level of pain intensity by adults (Hawker et al., 2011). Patients are asked to rate their level of pain on a 0-10 scale, with lower numbers representing less intense pain and higher numbers representing more intense pain. This outcome measure takes minimal time, approximately one minute at the most, to administer and is relatively simple for the patient to answer. The minimal detectable change (MDC), which is the minimally important change in score that is not caused by error, for this measure is a change of 2 points reported by the patient (Hawker et al., 2011).

Disablement in the Physically Active Scale. The Disablement in the Physically Active Scale (DPA) is a patient-reported outcome measure used to help determine an overview of the

level of disability in the active patient population (Houston et al., 2015). This outcome measure consists of both a physical summary component containing twelve questions and a mental summary component containing four questions. Each question is rated by the patient on a scale ranging from 0-4 where 0 indicates no problem, and 4 indicates the problem(s) severely affects the patient. The physical summary component is scored by the clinician, out of 48 points, and the mental summary component is scored out of 16. The overall total score of both components is 64. The minimal clinically important difference (MCID), which is the score that represents changes in a treatment outcome that is meaningful to the patient, for the total score of this measure has been found to be a change in score of 9 points in patients with persistent injuries (Vela & Denegar, 2010).

Procedures

Participant Recruitment. Prior to participation in this study, participants were assessed by a certified athletic trainer through a physical examination to determine if they met the inclusion criteria. The physical examination included an in depth history of injury, range of motion assessment, and muscular strength tests of the affected limb. Once the certified athletic trainer confirmed that the participant would be receiving ART, the primary investigator confirmed PHT by using diagnostic criteria as defined by Cacchio et al. (2012) by means of a positive Puranen-Orava test, a positive bent knee stretch test, and a positive modified bent knee stretch test.

Once it was confirmed that the participant met the inclusion criteria, the key personnel provided the participant with a recruitment announcement that described the study. Interested participants notified the primary investigator if they were interested in participating by marking a

yes or no box on the recruitment announcement. Individuals that indicated yes then signed an informed consent document before commencing the study.

Assessment. The diagnostic criteria used to confirm PHT described by Cacchio et al. (2012) included the Puranen-Orava test, bent-knee stretch test, modified bent-knee stretch test. The Puranen-Orava test was performed with the patient standing with their foot stabilized on a source of support, such as a treatment table, their hip flexed to 90 degrees and their knee extended in order to stretch their hamstring (Cacchio et al., 2012). The bent-knee stretch test was done with the patient lying on their back with their hip and knee flexed, then their knee is extended passively by the clinician (Cacchio et al., 2012). The modified bent-knee stretch test was performed in the same way as the bent-knee stretch test, but instead of the clinician passively extending the knee, the clinician rapidly extended the knee (Cacchio et al., 2012). Positive results of these tests were the reproduction of symptoms. After inclusion criteria was confirmed and the participant agreed to participate in the study by completing an informed consent form, they were then asked to complete both the Numeric Pain Rating Scale and the Disablement in the Physically Active Scale to obtain baseline information for their injury.

Intervention. After each participant completed the baseline assessments, ART was performed by a licensed athletic trainer who was also certified in ART. This technique involved the athletic trainer applying deep digital pressure to a tender point located in the involved area while the affected hamstring was moved from a shortened to lengthened position both actively and passively. Specifically, the treatment of the proximal hamstring involved the patient lying on their side with their hips in neutral and the affected knee extended. The clinician then placed their thumb or fingers near the ischial tuberosity over the muscle fibers that felt the tightest and applied tension proximally. Tension was then maintained while the clinician moved the hip into

flexion while keeping the knee extended (Leahy, 2008). Each participant was scheduled for treatment twice a week for four weeks. The Disablement in the Physically Active Scale was administered before treatment began and again once the treatment period commenced to measure dysfunction. The Numeric Pain Rating Scale was also administered before treatment began and again after every treatment, to efficiently monitor pain. The outcome measures were administered again at a follow-up session one week after the treatment period ended to obtain long-term outcomes.

Results

Three participants met the inclusion criteria and were included in the study. The Puranen-Orava test, bent knee stretch test, and the modified bent knee stretch tests were positive and provoked pain when performed on each participant. All three participants were receiving ART for their PHT prior to participating in this study.

Participants

Participant 1 was a 21-year-old female who had been suffering from hamstring tendinopathy for five years. This participant participated in sprinting, jumping, and throwing events. She stated that the initial cause of injury was from overuse. She was still participating in her sport while dealing with this injury, while also experiencing a hip flexor injury on the same leg. She received ART treatment in the past for her hamstring, piriformis, and hip flexor.

Participant 2 was a 23-year-old male who had been experiencing hamstring tendinopathy for two years. This participant was a sprinter and stated that the injury was originally caused by sprinting and had persisted ever since. He was still participating in his sport and did not have any other injuries. He received ART treatment in the past for great toe pain, which was caused by a sesamoid bone injury.

Participant 3 was a 22-year-old male who had been experiencing hamstring tendinopathy for approximately one month. This participant was a middle distance runner, which means his races are around 800 meters long. He could not recall how the injury initially occurred, but did state that he had experienced similar pain in the past. At the time of the study, he was still participating in his sport despite his injury. He had previously received ART treatment on his hamstring. Unlike the other two participants, he also received cupping treatment on the associated hamstring.

NPR Scale

When comparing post-testing and baseline results, all three participants demonstrated improvement, with two participants reporting a 0/10 (no pain) during the post-test assessment. These results met the Minimal Detectable Change (MDC) threshold of the NPR scale, which is a 2-point difference (Hawker et al., 2011).

Table 1

NPR Scale Results

Participant	1	2	3
Baseline	2	3	2
Treatment 1	0	3	1
Treatment 2	0	2.5	3
Treatment 3	0	2	2
Treatment 4	3	2	1
Treatment 5	1	1	4
Treatment 6	n/a	1.5	3
Treatment 7	n/a	1	3
Treatment 8	n/a	1	1
1 week follow up	0	1	0

Note. This table displays the results of the NPR Scale obtained after each treatment. Scores are based on a 0-10 scale.

DPA Scale

All three participants also reported improved scores during post-testing on the DPA scale from their baseline scores. Each participant also reported a 0/16 in the mental summary component of the scale during post-testing. All three participants' results obtained from the DPA scale for the post-test assessment met the MCID threshold of a 9-point change (Vela & Denegar, 2010).

Table 2

DPA Scale Results

Participant	1	2	3
Physical Summary	Possible score 48		
Baseline	22	20	13
Final Treatment	n/a	4	8
1 week follow up	7	2	2
Mental Summary	Possible score 16		
Baseline	2	1	4
Final Treatment	n/a	0	1
1 week follow up	0	0	0
Total Score	Possible score 64		
Baseline	24	21	17
Final Treatment	n/a	4	9
1 week follow up	7	2	2

Note. This table displays the results of the DPA Scale.

Adherence

Participant 1 was unable to attend all scheduled treatment sessions due to unforeseeable personal circumstances, so she received five treatments instead of the originally scheduled eight. The remaining two participants received eight treatments over a 5-week period. The treatment period was extended to 5 weeks, as opposed to the originally proposed 4 weeks, due to

unforeseeable circumstances that required the athletic trainer providing the treatment to be unavailable for a week.

Discussion

The results from this study provide important preliminary evidence and justification for further investigating the efficacy of ART for treating pain and dysfunction associated with PHT. All participants in this study reported clinically significant improvements of pain and dysfunction. Previous research has demonstrated similar findings when ART was used to decrease pain and improve function (George, Tepe et al., 2006; George, Tunstall et al., 2006; Kim et al., 2015; Miners & Bougie, 2011; Robb & Pajaczkowski, 2011; Tak et al., 2013). One of the most interesting findings was participant 1, who stated that she had never experienced so much pain relief in the five years that she had dealt with her injury. This improvement of long-term pain reveals the potential of ART as a useful intervention in decreasing pain in patients suffering from PHT for several years.

One of the main challenges associated with chronic injuries, such as PHT, is that symptoms may persist for long periods of time, contributing to dysfunction that can be well ingrained in a person's body. Due to this reason, chronic injuries may be difficult to resolve. It is important to note that the three participants in this study had been dealing with their injuries for varying lengths of time: participant 1 experiencing PHT for five years, participant 2 for two years, and participant 3 for approximately one month. Since all three participants reported significant pain reduction and functional improvements, this demonstrates the potential for ART to be an effective treatment for PHT injuries that span various lengths of time and varying degrees of deep-rooted dysfunction.

Participants were still participating in their sport during this study. High NPR scores were recorded after difficult workouts, which the participants stated particularly aggravated their injury. However, the decrease in NPR scores during post-testing suggests that ART may be a viable option for improving pain experienced by PHT. Similarly, participants' results from the DPA scale demonstrated a decrease in overall dysfunction caused by their injury, demonstrating that ART may improve impairments caused by PHT. While baseline testing for the mental summary component of the DPA scale showed very low scores initially, participants reported scores of 0/16 during post-testing. This demonstrated that there was also a slight improvement of mental health in these participants.

Limitations

This study, although carefully conducted, does not go without limitations. A control was not used and patients were not blinded to their treatment. The study was based on clinical observation and outcomes and was subject to the ever-changing schedules of athletes and athletic trainers. Therefore, in some cases it was difficult to strictly adhere to the original treatment schedule of two treatments per week for a total of four weeks.

Suggestions for Future Research

Since there was no control group, future research involving studies that are a higher level of evidence, such as a blinded randomized controlled trial, are needed to confirm the efficacy of ART for improving pain and dysfunction caused by PHT. This study described the outcomes of collegiate athletic patients with PHT that were treated with ART. Future research should explore other patient populations.

Conclusions

In conclusion, PHT is a chronic injury that can be difficult to treat and leave people who suffer from it feeling frustrated due to persistent pain and dysfunction. ART is a manual therapy that has demonstrated to be an effective treatment for improving pain and function in other chronic injuries. There are currently various interventions used to treat PHT, but patient outcomes for the use of ART for PHT had not yet been assessed. The purpose of this study was to describe pain and functional outcomes of patients with PHT treated with ART. This study found significant results in the improvement of pain and dysfunction caused by PHT. By the end of the study, all three participants reported 0/10 (no pain) on the NPR scale, demonstrating the potential of ART being effective at managing pain related to PHT. All participants' scores on the DPA scale improved and met the MCID threshold of nine at the time of post-testing, indicating the possibility that ART may be effective at improving function and mental health in the treatment of PHT. Based on these findings, researchers should investigate the efficacy of ART on pain and dysfunction in patients with PHT in a controlled setting. This would help ensure that ART is the reason for these improvements as opposed other potential patient characteristics and confounding variables. It would also be beneficial for future research to explore this topic in other patient populations in addition to the collegiate athletic population.

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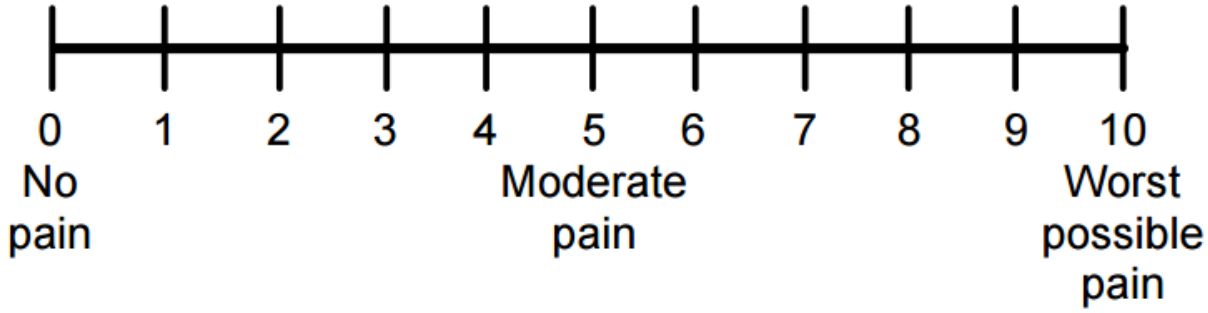
Appendix A

NPR Scale

Please circle the number on the scale line that represents the pain you experience at this moment.



Appendix B

DPA Scale

Disablement in the Physically Active Scale©

Instructions: Please answer **each statement** with one response by shading the square that most closely describes your problem(s) within the past **24 hours**. Each problem has possbile descriptors under each. Not all descriptors may apply to you but are given as common examples.

0- No problem
1- I have the problem(s), but it does not affect me
2- The problem(s) slightly affects me
3- The problem(s) moderately affects me
4- The problem(s) severely affects me

	No Problem	Does not affect	Slight	Moderate	Severe
DPA-Physical Summary Component	0	1	2	3	4
Pain- "Do I have **pain**?"	☐	☐	☐	☐	☐
Motion- "Do I have impaired **motion**?" Ex. Decreased range/ease of motion, flexibility, and/or increased stiffness	☐	☐	☐	☐	☐
Muscular Functioning- "Do I have impaired **muscle function**?" Ex. Decreased strength, power, endurance, and/or increased fatigue	☐	☐	☐	☐	☐
Stability- "Do I have impaired **stability**?" Ex. The injured area feels loose, gives out, or gives way	☐	☐	☐	☐	☐
Changing Directions- "Do I have difficulty with **changing directions** in activity?" Ex. Twisting, turning, starting/stopping, cutting, pivoting	☐	☐	☐	☐	☐
Daily Actions- "Do I have difficulty with **daily actions** that I would normally do?" Ex. Walking, squatting, getting up, lifting, carrying, bending over, reaching, and going up/down stairs	☐	☐	☐	☐	☐
Maintaing Positions- "Do I have difficulty **maintaining the same position** for a long period of time?" Ex. Standing, sitting, keeping the arm overhead, or sleeping	☐	☐	☐	☐	☐
Skill Performance- "Do I have difficulties with **performing skills** that are required for physical activity?"					
1) Ex. Running, jumping, kicking, throwing & catching	☐	☐	☐	☐	☐
2) Ex. Coordination, agility, precision & balance	☐	☐	☐	☐	☐
Overall Fitness- "Do I have difficulty maintaining my **fitness** level?" Ex. Conditioning, weight lifting & cardiovascular endurance	☐	☐	☐	☐	☐
Participation in Activites- "Do I have difficulty with **participating in activities**?"					
1) Ex. Particpating in leisure activities, hobbies, and games	☐	☐	☐	☐	☐
2) Ex. Participating in my sport(s) of preference	☐	☐	☐	☐	☐

DPA-Physical Score = _____/ 48

DPA-Mental Summary Component					
Well-Being- "Do I have difficulties with the following…?"	0	1	2	3	4
1) Increased uncertainty, stress, pressure, and/or anxiety	☐	☐	☐	☐	☐
2) Altered relationships with team, friends, and/or colleagues	☐	☐	☐	☐	☐
3) Decreased overall energy	☐	☐	☐	☐	☐
4) Changes in my mood and/or increased frustration	☐	☐	☐	☐	☐

DPA-Mental Score = _____/ 16

DPA-Total Score = _____/ 64

(DPA-Mental + DPA-Physical)

Appendix C

RECRUITMENT SCRIPT

Hello, my name is Madison Hagedorn. I am a senior athletic training student at the University of Northern Iowa. I am conducting a research study here at the University of Northern Iowa concerning the outcomes of your Active Release Technique treatment. This letter provides you with details about the study and information on how to inform me if you are interested in participating.

Appendix D

HUMAN PARTICIPANT REVIEW INFORMED CONSENT

UNIVERSITY OF NORTHERN IOWA
HUMAN PARTICIPANT REVIEW
CONSENT FORM

Project Title: The effectiveness of active release technique on hamstring tendinitis
Name of Investigator(s): Madison Hagedorn and Dr. Tricia Schrage

Invitation to Participate: You have been invited to participate in a research study conducted by Madison Hagedorn as part of an honors thesis project for completion of a Bachelors of Arts degree in Athletic Training through the University of Northern Iowa. Your decision to participate in this study is entirely voluntary. Please read the information about the study below and be sure you understand it entirely before deciding whether or not to participate.

You have been asked to participate in this study because you have indicated that you have hamstring tendinitis and your athletic trainer has suggested Active Release Therapy (ART). This technique is commonly used to treat tendon and muscle pain and we would like to study its effectiveness. Active Release Therapy is a noninvasive technique that will involves your certified athletic trainer applying deep pressure with her fingers to a tender point located over your tendon in the involved area, while your affected hamstring muscle is moved from a shortened and to lengthened by moving your hip and knee.

You will be excluded from the research study if you have the following:

1. An acute injury, blunt trauma, or skin disorder
2. You are unable to physically tolerate ART
3. Have a history of tendon rupture or other musculoskeletal injury on the involved limb
4. Are unable to regularly attend scheduled treatment sessions

Nature and Purpose: The purpose of this research is to investigate the effectiveness of ART on pain and dysfunction caused by hamstring tendinitis. If you decide to participate, you will first be evaluated to determine if you are a candidate to participate in this study. If you qualify, you will then be asked to complete 3 surveys before your first treatment, 1 pain survey before and after each treatment during your 2 weekly ART treatment sessions for 4 weeks, and 1 function survey after the 8th treatment (4th week). You will also be asked to complete 2 surveys one week after your final ART treatment (at least 5 weeks after the study begins). *(If you don't qualify to participate in the research, it will not affect the treatments provided by your athletic trainer).* Your participation for the first session will be approximately 15 minutes. Subsequent sessions for completing the pain scale will take 1 minute. The 8th and final session will last approximately 4 minutes. Therefore, your total time for participation should be approximately 40 minutes, spread out over the 9 sessions.

Explanation of Procedure: If you volunteer to participate in this study, you will be asked to do the following after we receive your consent:

1. A licensed athletic trainer will also conduct a physical examination to ensure that you meet the inclusion criteria and that ART is warranted. Below are the inclusion/exclusion criteria for our study:
    a. Inclusion: You will be able to participate in this study if you have:
        i. Confirmed hamstring tendinitis by using diagnostic criteria by means of a positive straight leg hamstring stretch test and two different bent knee hamstring stretch tests. We can demonstrate these techniques for you before you decide to participate.
2. If we determine that it is safe for you to participate, you will then begin the study protocol. First you complete a questionnaire about your health history. Next you will be asked to complete two surveys: one for function (16 questions) and one for pain (1 question).
3. For the next 7 scheduled session, you will return to the University of Northern Iowa Athletic Training Facility and the licensed athletic trainer will perform an ART treatment, followed by the pain survey (1 question).
4. During the 8th session, you will also be asked to complete the functional survey (16 questions) in addition to the pain survey (1 question).
5. One week after your last ART treatment, you will be asked to complete the functional survey (16 questions) and pain survey (1 question). Participation will be considered complete at this time.

Discomfort, Risks, and Costs: The risks for participating in this study are minimal and are no greater than experienced in everyday life.

Benefits and Compensation:
There will be no direct benefits or compensation that you will receive from participating in this research study.

Privacy and Confidentiality:
Information obtained during this study, which could identify you, will be kept confidential. Only the principal investigator and the faculty advisor will have access to the data to analyze the results. Your responses to the surveys will not be shared with your athletic trainer. The summarized findings with no identifying information may be published in an academic journal or presented at a scholarly conference.

Right to Refuse or Withdraw:
Participation in this study is on a voluntary basis only. You have the right to withdraw from the study at any time and for any reason, or to choose not to participate at all. You may also refuse to answer any questions you do not want to answer. By exercising this right, you will not be penalized in any way. Your health care or participation in sports will not be affected by either participating in this study, or choosing not to participate.

Questions:
"If you have questions regarding your participation in this study or about the study generally, please contact Madison Hagedorn or Tricia Schrage (see below). For answers to questions about the rights of research participants and the research review process at UNI, you may contact the office of the IRB Administrator at 319-273-6148."

Principle Investigator: Madison Hagedorn (712)-304-1758 hagedorm@uni.edu	Faculty Advisor: Tricia Schrage, EdD, LAT, ATC tricia.schrage@uni.edu, 319-273-7493 University of Northern Iowa OO3 HPC

Agreement*: I am fully aware of the nature and extent of my participation in this project as stated above and the possible risks arising from it. I hereby agree to participate in this project. I have received a copy of this form.*

_____ _____
(Signature of participant) (Date)

_____
(Printed name of participant)

_____ _____
(Signature of investigator) (Date)

_____ _____
(Signature of faculty advisor) (Date)

Appendix E

HEALTH HISTORY FORM

Subject Number: _____

Post-Consent Health History Form
PLEASE DO NOT PUT YOUR NAME ON THIS PAPER

Ht.___ feet**____** inches **Wt._____** pounds **Age:_____** **Gender:** M F Transgender

1. Describe your injury _____
    a. Location: **Left Right (circle one)**
    b. Date of injury (if known) _____
    c. Cause of injury (if known)? _____
    d. Have you experienced this injury in the past? _____
    e. Please circle your current participation status:
        i. Injured and not participating
        ii. Injured but still participating
2. Do you currently have any other injury or condition? **Y N**
    a. If yes, what side is the other injury located? **Left Right**
    b. Please describe the injury type_____
3. Have you received Active Release Technique in the past?
    a. If yes, please describe_____
4. Do you have an acute injury, blunt trauma, or skin disorder? **Y N**
5. Do you have a history of tendon rupture or other musculoskeletal injury on the involved limb? **Y N**
6. Are you able to attend treatment sessions for 4 weeks, twice a week? **Y N**

If you answered "YES", to any relevant questions, or you are unsure about any of your answers, you will be asked for more detail to help the researcher better assess whether your condition increases your risk for participation.