PLATELET-RICH PLASMA INJECTIONS AND COLLEGIATE ATHLETIC TRAINER'S PREVENTION, EVALUATION, TREATMENT, AND REHABILITATION FOR HAMSTRING INJURIES

by

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A Thesis Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Exercise Science

Middle Tennessee State University

May 2022

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ACKNOWLEDGMENTS

I would like to thank my thesis committee for helping me along the way to getting this complete. Dr. Coons, thank you for encouraging me and keeping me on task throughout the year. Dr. Stevens, thank you for all your help with figuring out the data and making this feel easier. To my dog Dor, thanks for sleeping on my lap while I wrote this and distracting me when needed.

ABSTRACT

The purpose of this study was to assess the prevention, evaluation, treatment, and rehabilitation methods being used by collegiate athletic trainers for hamstring strain injuries (HSI) to reduce the risk of reinjury and to determine whether platelet-rich-plasma injections are being used as a method of treatment. National Athletic Training Association (NATA) members working in the collegiate setting were asked to complete a survey through Qualtrics for this study. Results from this study showed a significant difference in PRP injection usage when Division 1 was compared to all other divisions, athletic trainers were likely to evaluate lumbopelvic rotation, bilateral hip flexor flexibility, gluteus maximus strength, and gluteus minimus strength when assessing a HSI, and they reported using eccentric exercises, conventional resistance exercises, stretching, myofascial release, and core training most of the time or always when rehabilitating a HSI. These results suggest that PRP injections are not being used as often as they should in collegiate athletics and athletic trainers are doing comprehensive evaluations and rehabilitations for HSIs.

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

LIST OF ABBREVIATIONS

HSI	Hamstring Strain Injury
NSAID	Non-Steroidal Anti-Inflammatory Drug
NATA	National Athletic Training Association
PRP	Platelet-Rich Plasma
RICE	Rest, Ice, Compression, Elevation

CHAPTER I:

INTRODUCTION

Hamstring strain injuries are one of the most prevalent injuries in athletics (Garrett, 1996; Ekstand et al., 2011; Feeley et al., 2008; Opar et al., 2014) leading to time loss (Cohen et al., 2011) and decrease athletic performance (Verrall et al., 2006). There are many different risk factors that cause hamstring strains including reciprocal inhibition, synergistic dominance, and previous injury. Reinjury of the hamstring has been shown to be between 16-32% of all hamstring muscle strains (Ekstand et al., M., 2011; Heiser et al., 1984). Reducing the risk of reinjury begins with a proper evaluation of an injury which in collegiate athletics is typically performed by an athletic trainer.

In an evaluation of a hamstring strain injury, risk factors should be assessed to individualize treatment and rehabilitation to reduce risk of reinjury. Lumbopelvic rotation can be assessed to determine whether the biceps femoris muscle was placed on a stress due to an anterior pelvic tilt (Higashihara et al., 2015; Mediguchia et al., 2020, Olesky et al., 2021). Bilateral hip flexor flexibility should be assessed to determine whether the contralateral psoas muscle is causing increased tension on the hamstring muscle group (Chumanov et al., 2007). Gluteus maximus strength/activation should be assessed due to the increased activation of the hamstring muscles for hip extension when the glute strength/activation is lower (Mills et al., 2015).

Treatment and rehabilitation can include a multitude of options including rest, ice, compression, elevation, non-steroidal anti-inflammatories, rehabilitative exercises, and injections. Injections for hamstring strain injuries include corticosteroid injections and platelet-rich-plasma (PRP) injections. PRP injections have been shown to reduce the

muscle scarring after a hamstring strain injury (Zanon et al., 2016). A reduction in muscle scarring decreases the strain on the muscle fibers. PRP injections have also been shown to decrease return to play time (A Hamid et al., 2014; Bezuglov et al., 2019; Gaballah et al., 2018; Trunz et al., 2021) and reduce risk of reinjury (Trunz et al., 2021).

Reducing the risk of reinjury in hamstring strains is a critical component to treatment/rehabilitation of the injury. With an increased risk of injury following an initial hamstring strain, it is important to evaluate the cause of injury and then address the cause as well as the effects of the injury with treatments and rehabilitations. With no standardized protocol for hamstring strains, there can be a multitude of treatments and types of rehabilitative exercises used by an athletic trainer to treat their athlete. For hamstring strain injuries, there is important new findings in regard to decreasing the risk of reinjury through platelet-rich-plasma injections and addressing the risk factors associated with each athlete's injury. Research to determine whether athletic trainers are incorporating the new research findings into their treatment/rehabilitations needs to be done to ensure best practice is being performed/

Purpose of Study

The purpose of this study was to assess the prevention, evaluation, treatment, and rehabilitation methods being used by collegiate athletic trainers for hamstring strain injuries to reduce the risk of reinjury and to determine whether platelet-rich-plasma injections are being used as a method of treatment.

Hypotheses

1. Division I athletic trainers will use platelet-rich-plasma injections for hamstring strain injuries more often than other collegiate athletic trainers.
2. Lumbopelvic rotation will be evaluated less often than bilateral hip flexor flexibility and gluteus maximus and gluteus minimus strength.
3. Physicians will suggest PRP injections more often in moderate to severe hamstring strains than all hamstring strain injuries.

Delimitations

1. This study was limited to members of the National Athletic Training Association (NATA).
2. This study was limited to being sent out to 1,000 individuals.

Limitations

1. Participants were athletic trainers working in the collegiate setting.

Basic Assumptions

1. Participants answered all questions honestly and to the best of their knowledge.

Significance of Study

1. Physicians and athletic trainers need to become more aware of the benefits of PRP injections and implement them in athletes with moderate-to-severe hamstring strains.
2. Athletic trainers are using a multiple component evaluation and rehabilitation for the athletes with HSIs.

CHAPTER II:

LITERATURE REVIEW

In this literature review, hamstring muscle strain risk factors, practices in treating hamstring muscle strains and the use of platelet-rich plasma injections are reviewed. The chapter begins with a general review of the prevalence, physiology, risk factors, and reinjury rates associated with injury to the hamstring muscle group. Next, treatment and rehabilitation options for hamstring muscle strains are reviewed focusing specifically on rest, ice, compression, elevation, non-steroidal anti-inflammatory drugs (NSAIDs), rehabilitative exercises, intramuscular corticosteroid injections, and platelet-rich plasma injections, with greater emphasis on platelet-rich plasma injections. Specifically, their effects on return to play time, and risk of reinjury following the injection. The review ends with a summary of the literature highlighting the importance of reducing reinjury in athletes with hamstring strains and the importance of determining risk factors that lead to the initial injury.

Hamstring Muscle Injuries

Prevalence

Hamstring strain injuries (HSIs) are one of the most frequent injuries in athletics (Garrett, 1996; Ekstand et al., 2011) and are the most prevalent muscle group injury in soccer (Ekstand et al., 2011), American football (Feeley et al., 2008), and track and field (Opar et al., 2014). Hamstring injuries have been reported to account for 26% of all injuries in track and field (Opar et al., 2014), 13-15% in Australian football (Seward et al., 1993), 12-14% in soccer (Ekstand et al., 2011; Hawkins et al., 2001), and 12% in

American football (Feeley et al., 2008). Because of the high prevalence of HSIs, the physiology of the injury must be understood.

Physiology

Currently, research suggests that a combination of both high eccentric force (Yu et al., 2008; Chumanov et al., 2007) and other strains on the muscle (Garrett, 1996) are responsible for the etiology of HSIs. Some research suggests that chronic microscopic damage to the muscle (Morgan, 1990) or a single event causing injury could be responsible for HSIs (Verrall et al., 2005), but there is not clarity on either theory. Crema et al. (2016) found that the most common site of injury for HSI is at the proximal myotendinous junction, which also yields the most edema. However, injuries to the distal hamstrings were found to result in more extensive tearing of the muscle fibers (Crema et al., 2016). The most injured hamstring muscle, in an isolated muscle injury, is the biceps femoris (Silder et al., 2008). Regardless of the specific location of HSI, the extent of the injury such as grade (I, II, or III), muscle involvement (one or more hamstring muscles), and percentage of the muscle involved shown on a magnetic resonance imaging (MRI) has been shown as a reliable way to determine the severity of the injury and time loss from sport participation (Cohen et al., 2011). Time lost from a HSI can be extensive and affects both training and competition in athletes (Brooks et al., 2006), which can result in a financial loss (Woods et al., 2002) and decreased athletic performance (Verrall et al., 2006).

Risk Factors

Sports involving sprinting, change of direction, kicking, and high intensity running and stopping have increased incidence of hamstring muscle strains (Heiderschit

et al., 2010; Chumanov et al., 2007; Seward et al., 1993). Along with sport demands, there are several characteristics of athletes that can predict the risk of HSI. For example, those at higher risk of HSI tend to be older (Green et al., 2020), have a significantly lower hamstring-to-quadriceps strength ratio (Lee et al., 2018), hip flexor restriction/gluteus maximus reciprocal inhibition (Mills et al., 2015; Gabbe et al., 2006; Chumanov et al., 2007), and have had a previous hamstring injury (Green et al., 2020; Lee et al., 2018; Tokutake et al., 2018). Identifying the predisposing factor/s after an initial HSI occurs plays an important role in prescribing targeted rehabilitation and intervention as well as a reduced risk of reinjury (Croisier, 2004).

Altered Reciprocal Inhibition/Synergistic Dominance

Reciprocal inhibition allows for a muscle on one side of the body to relax while the muscle on the opposite is fully contracted. Regarding muscle flexibility, reduced flexibility of the hip flexors has been associated with an increase in hamstring strain injuries (Gabbe et al., 2006). The contralateral psoas muscle has been shown to have a greater influence on a hamstring length than the hamstring muscle itself (Chumanov et al., 2007). Mills et al. (2015) found that with decreased hip flexor flexibility, gluteus maximus activation decreased resulting in an increased activation of the hamstring muscles for hip extension.

Lumbopelvic Rotation

With the biceps femoris muscle being the most injured (Silder et al., 2008), studies have investigated the relationship between the biceps femoris origin on the ischial tuberosity and sacrotuberous ligament and changes associated with an anterior pelvic tilt (Higashihara et al., 2015; Mediguchia et al., 2020). Anterior pelvic tilt causes increased

strain on the long head of the biceps femoris with most strain at the proximal and distal attachment points (Oleksy et al., 2021), which is the most common site of muscle tears (Crema et al., 2016). An anteriorly rotated pelvis causes an increased stretch on the hamstring muscle group, altering the length-tension relationship, causing the reduced ability to produce force at an increased muscle length (Mendiguchia et al., 2012).

Reinjury

Despite advances in etiology and rehabilitation, there has not been a reduction in hamstring strain injuries or reinjury rates over the past three decades (Mendiguchia et al., 2012). As previously mentioned, one risk factor for HSI is having a previous hamstring injury (Green et al., 2020; Lee et al., 2018; Tokutake et al., 2018). There is evidence of this in a sports context, where reinjury of the hamstring muscles has been reported in 32% of all hamstring injuries in American football (Heiser et al., 1984) and 16% in soccer (Ekstand et al., M., 2011). Prior injury to the hamstrings can cause structural changes such as reduced fascicle length (Timmins et al., 2016), reduced flexibility (Ekstrand & Gillquist, 1982), atrophy (Sanfilippo et al., 2013; Silder et al., 2008), and non-functional scar tissue (Silder et al., 2008; Croisier, 2004). When studying the specific changes that occur with reinjury at the myotendinous junction, Silder et al. (2010) suggest that prior HSI at this site causes proliferation of scar tissue leading to a greater strain on the adjacent musculature when performing eccentric contractions. The adaptation caused by the scarring affects the muscle lengthening mechanics leading to the increased risk of reinjury due to the increased strain on the muscle fibers (Silder et al., 2008; Lieber & Fridén, 1993).

Treatment/Rehabilitation of Hamstring Strains

Despite the high incidence of HSIs, there is no true consensus on the most efficient method to treat the injury (Orchard et al., 2008). The main goal for treatment and rehabilitation of HSIs is to return the athlete to their sport at the level they were performing at prior to the injury with the least chance of reinjury. To do so, modifiable risk factors should be addressed within rehabilitation, which includes addressing hamstring-to-quadriceps strength ratio (Lee et al., 2018), hamstring strength/flexibility (Lee et al., 2018; Worell, 1994), and eccentric strength (Opar et al., 2012). Based on research, there are many different interventions used in the management of HSI including rest, ice, compression, elevation (Almekinders, 1999), non-steroidal anti-inflammatory drugs (NSAIDs; (Mehallo et al., 2006), therapeutic exercises/rehabilitation (Heiderschit et al., 2010), eccentric exercises (Brooks et al., 2006), corticosteroid injections (Levine et al, 2000), and autologous platelet-rich plasma (PRP) injections (Hamilton et al., 2010; Gaballah et al., 2018).

Rest, Ice, Compression, Elevation

Rest, ice, compression, and elevation (RICE) is considered a standard approach in the treatment of most types of injuries including acute soft tissue injuries such as HSIs (Almkinders, 1999). This type of treatment is typically used early on, whereas later in treatments stretching and strengthening exercises would be added (Almkinders, 1999). Thorsson et al. (1997) showed the usage of external compression immediately following an acute muscle injury, including muscle contusions and strains, had no significant reduction in hematoma size nor did it significantly shorten the return to play time compared to the control subjects. There are no significant harmful effects from RICE as a

treatment shown, but it is unclear whether it is effective alone with acute muscle injuries such as HSIs (Almkinders, 1999). Although its full effectiveness is unknown, RICE has been used with acute HSIs for reduction in hemorrhaging, inflammation, and pain (Drezner, 2003; Almkinders, 1999).

Non-Steroidal Anti-Inflammatory Drugs

Treatment using non-steroidal anti-inflammatory drugs prescribed by a physician are common with athletic injuries to aid in pain control, decrease the body's inflammatory response after injury, and help return the athlete to their sport (Mehallo et al., 2006). Reynolds et al. (1995) studied, over 7 days, the effects of two different NSAIDs compared to a placebo group in combination with an intense exercise therapy program. The results showed no difference in pain, inflammation, or isokinetic strength (Reynolds et al., 1995). Non-steroidal anti-inflammatories have been found to be effective short-term in decreasing pain, improving muscle recovery, and decreasing return to play time, but the long-term effects on healing may lead to impairments in muscle repair and regeneration (Mehallo et al., 2006).

Rehabilitative Exercise Programs

Rehabilitation through different types of exercises such as eccentric strength training (Brooks et al., 2006; Proske et al., 2004) and neuromuscular control exercises (Brooks et al., 2006) have shown to reduce the incidence of hamstring injuries. There is evidence that a post-HSI rehabilitation program with an emphasis on eccentric exercises versus conventional exercises allows for a significant decrease in return to sport time in sprinters and jumpers and elite football players (Askling et al., 2013; Askling et al., 2014). Eccentric exercises, such as the Nordic hamstring curl, have also been correlated

with decreases in the severity of HSI in athletes (Brooks et al., 2006). Proske et al. (2004) suggest that incorporating eccentric exercise training into rehabilitation may reduce the risk of reinjury with HSIs by shifting peak force development, allowing for musculotendinous length to be optimal for tension production.

Eccentric exercises can also be combined with neuromuscular control exercises for a rehabilitative program. Neuromuscular control exercises such as progressive agility and trunk stabilization showed a significant reduction in reinjury compared to a progressive stretching and strengthening (STST) program (Sherry & Best, 2004). Silder et al. (2013) compared the progressive agility and trunk stabilization program with an eccentric training and progressive running program and found no significant differences in return to sport time following a HSI. Although both programs showed low reinjury rates, MRIs revealed neither group showed complete injury healing after completing the rehabilitation program and becoming cleared to return to sport (Silder et al., 2013). Oleksy et al. (2021) suggests that with any rehabilitation protocol, including eccentric strength training, an evaluation of the lumbo-pelvic complex alignment should be performed and corrected to allow for an optimal length of the biceps femoris which can increase results from eccentric training. Along with rehabilitation protocols, doctors can inject the muscle group with different types of compounds, such as corticosteroid or platelet-rich plasma.

Injections

Intramuscular corticosteroid injections have been viewed as controversial for muscular tendonous injuries because of the possible association with tendon ruptures (Acevedo & Beskin, 1998). Levine et. al (2000) studied intramuscular corticosteroid

injection in hamstring muscle injuries in NFL football players and the safety of the injections, finding the injections are generally safe to use for HSIs (Levine et al., 2000). Although corticosteroid injections as a treatment for acute HSI needs to be further studied for clinical usage (Chu & Rho, 2016), Nicholson et al. (2014) found that these types of injections allowed for significant decreases in pain and an increase the in level of athletic performance at 21 months post-injection in patients with proximal hamstring tendinopathies. There is a lack of research on reinjury rates following corticosteroid injections for hamstring strain injuries.

Another type of intramuscular injection option for patients following a HSI is a PRP injection. These are performed by drawing blood from a peripheral vein. After blood is drawn, it is placed in a centrifuged to separate the plasma. The plasma is then injected into the injury site. The severity of the injury typically determines the number of PRP injections needed throughout the healing process. Park et al. (2019) compared the effectiveness of pain relief on HSIs on grade II proximal HSIs between those treated with a steroid injection versus a PRP injection. Results showed that PRP injections provided greater pain relief than the steroid injection within a week of injury (Park et al., 2019).

Platelet-Rich Plasma Injections and Hamstring Muscle Strains

Physiology of Platelet-Rich Plasma Injections

Platelet-rich plasma injections can be used as an augmentation to the healing process through the properties of growth factors, cytokines, and other molecular mediators found concentrated in autologous blood which aid in myotendinous healing (Braun et al., 2014). The PRP injection causes an exponential increase in many growth factors, the ones pertaining to muscle strains are shown in Table 1 along with their

cellular effects (Middleton et al., 2012). Thanasas et al. (2011) found that immediately following a PRP injection, an increase in the local inflammatory response causes an initial temporary increase in pain, but when compared to autologous whole blood, the PRP injections showed pain relieve sooner.

Table 1

Growth Factors and Cellular Effects (Middleton et al., 2012)

Growth Factor	Cellular Effects
PDGF ***Platelet Derived Growth Factor***	- Macrophage activation and angiogenesis - Enhances collagen synthesis - Enhances the proliferation of bone cells
IGF-I ***Insulin-like Growth Factor-I***	- Chemotactic for myoblast and fibroblasts - Stimulates protein synthesis - Mediator in growth and repair of skeletal muscle
TGF-β ***Transforming Growth Factor-β***	- Enhances the proliferative activity of fibroblasts - Simulates biosynthesis of type I collagen and fibronectin - Regulation in balance between fibrosis and myocyte regeneration
PDAF ***Platelet Derived Angiogenic Factor***	- Induces vascularization by stimulating vascular endothelial cells

As mentioned prior in the literature review, scar tissue formation causes additional strain on the muscle and can lead to reinjury (Lieber & Fridén, 1993; Silder et al., 2010). Zanon et al. (2016) found that PRP injections promote the healing of stable muscle scarring which may lead to a decreased risk of reinjury. Platelet-rich plasma injections also yield earlier functional improvements and more complete recovery compared to rehabilitation alone (Gaballah et al., 2018).

Return to Sport Times with Platelet-Rich Plasma Injections

Return to sport time is a common outcome measure in studies looking at the effectiveness of different treatment options. Regarding HSIs treated with PRP injections, studies show a significant decrease in return to sport time (A Hamid et al., 2014; Bezuglov et al., 2019; Gaballah et al., 2018, Trunz et al., 2021). In a study comparing conservative treatment (therapeutic exercises) alone or combined with PRP injections in professional soccer players, Bezuglov et al. (2019) found evidence that PRP injections along with a rehabilitative protocol used on grade II HSI allowed for a decrease in return to sport time with no adverse effects (Bezuglov et al., 2019). A Hamid et al. (2014) compared rehabilitation only to rehabilitation with a PRP injection in athletes in a variety of sports who were diagnosed with an acute HSI showing that a single PRP injection combined with a rehabilitation program shortened return to sport time and severity of pain. Although there are results showing return to sport time is reduced in those receiving PRP injections, Hamilton et. al (2015) found no significant benefit of a single PRP injection in return to sport time when compared to rehabilitation alone suggesting that the number of injections could influence return to sport time. Further studies are needed to

determine the effectiveness of the number of PRP injections received on return to sport time.

Risk of Reinjury After Platelet-Rich Plasma Injection

With the risk of reinjury being high as mentioned prior in this literature review, reductions in these rates are critical for athletes after initial injury occurs. Hamilton et al. (2015) studied the effectiveness of a single PRP injection following an acute HSI and used two- and six-month reinjury rates as a secondary outcome measure. The study found no significant difference in reinjury rates at both two and six months, with 6-month reinjury occurring in 2 of 26 patients in the PRP group and 3 of 28 patients in the non-injection group. Zanon et al. (2016) examined 25 professional male soccer players with grade II HSIs and found a 12% reinjury rate in those receiving two or three PRP injections for treatment with reoccurrence only involving the biceps femoris muscle, but there was no comparison to those not treated with PRP injections.

Seow et al. (2021) performed a systematic review and meta-analysis on best- and worst-case scenarios with PRP injections for HSI treatment, finding that there was no significant difference in return to play time and reinjury rates in those treated with and without PRP injections. Of the ten articles meeting their criteria, only four included reinjury rates with most studies having a follow-up timeline of approximately 6 months. The articles used in this systematic review and meta-analysis showed the lack of standardization of PRP injection protocols for when to use injection, the preparation of the injection, and the number of injections with effectiveness on HSIs (Seow et al., 2021). While there is no evidence for HSIs specifically, science shows that PRP injections

should be used during the post inflammatory phase (Chan et al., 2006), but Seow et al. (2021) found no standardization in studies for when they performed the injections.

Although no standardization in PRP protocol has been determined, a recent study by Trunz et al. (2021) found a decrease in both reinjury risk and return to play time with PRP injections and hematoma aspiration versus conservative treatment. A total of 55 athletes with an acute hamstring strain were included in the study and results with regards to reinjury rates showed 1/27 in the PRP group and 8/28 in the conservative treatment group had reinjury within 2 years post initial injury (Trunz et al., 2021). With multiple studies showing reduction in return to play time (A Hamid et al., 2014; Bezuglov et al., 2019; Gaballah et al., 2018; Trunz et al., 2021). and a reduction in reinjury rates (Trunz et al., 2021), it is important to determine if PRP injections are being used for hamstring strains among collegiate athletics.

Multicomponent Hamstring Strain Prevention

With the multitude of risk factors that can play a role in hamstring strain injuries, individualizing rehabilitation plans can be important in the prevention of injury and the reduction of reinjury. Suarez-Arrones et al. (2021) found that using a multicomponent prevention program consisting of strength training with specific posterior chain exercises, on-field training control, physiotherapy treatment, management of training load, individual training (based on weaknesses such as previous injury), and communication and individualized management of players allowed for approximately 3 times reduction in hamstring strain injuries over two seasons in soccer players. In this study the strength program focused exercises to reduce risk factors including reduced flexibility/mobility of hip flexors, hip extensor activation (gluteus maximus), hip stabilization (gluteus medius),

and lumbo-pelvic control (Suarez-Arrones et al., 2021). Physiotherapy treatment was used to address scar tissue in previously injured athletes and myofascial induction to reduce tension in the fascia (Suarez-Arrones et al., 2021). Suarez-Arrones et al. (2021) not only found the reduction of hamstring strain injuries, but also had zero reoccurrences of hamstring strains during the two years that the intervention was in place. This study by Suarez-Arrones et al. (2021) was compared with studies that used the Nordic Hamstring Exercise (NHE) program, which focuses on eccentric strength, to highlight the importance of a multicomponent approach with individualized interventions.

Summary of Literature Review

This review of the literature shows the impact of hamstring strain injuries on athletes and the effectiveness of treatment types including rest, ice, compression, elevation, non-steroidal anti-inflammatory drugs, rehabilitative exercises, intramuscular corticosteroid injections, and platelet-rich plasma injections on reinjury rates of hamstrings. The risk factors associated with hamstring strains emphasized the impact of a prior HSI to significantly increase the risk of having another. Reducing the risk of reinjury was proven to be significant for athletes regarding time lost from sport and reduction in HSIs. Results of studies signified that PRP injections could increase growth factors that benefit the healing process of a muscle strain (Middleton et al., 2012).

Hamstring strain injuries and the effects of PRP injection on return to play have been studied significantly, but lacks a consensus on number of injections, preparation, and timing of injections. With high risks of reinjury of the hamstring muscles (Green et al., 2020; Lee et al., 2018; Tokutake et al., 2018), reduction of risk of reinjury is critical for athletes. Rehabilitation alone showed a lack in full healing of the muscle fibers (Silder

et al., 2013), whereas HSIs injected with platelet-rich plasma showed more complete healing with less significant scarring of the muscle (Zanon et al., 2016). With better physiologic healing of a muscle after a HSI, one can reasonably hypothesize that reinjury caused by muscle scarring effects on the muscle function could be reduced (Lieber & Fridén, 1993). Trunz et al. (2021) showed that PRP injections can reduce the risk of reinjury following an initial hamstring strain. With PRP injections showing important benefits, it is critical to determine whether they are being implemented in the treatment/rehabilitation protocol for athletes. Addressing other modifiable risk factors such as lumbopelvic rotation and reciprocal inhibition through an individualized rehabilitation program has also showed reduction in reinjury rates (Suarez-Arrones et al., 2021). These treatment types could allow for a more standardized care plan for HSIs with maximal benefits, reduced time lost for injury, and reduction of decreased athletic performance following an injury.

It is important to research the application of prevention, evaluation, treatment, and rehabilitation of hamstring strains and reinjury. An individualized prevention program can lead to fewer number of hamstring strain injuries and reinjuries. A proper evaluation checking for strength imbalances and synergistic dominance can allow for a more tailored rehabilitation program to address risk factors. Treatment and rehabilitation can allow for optimal healing and prevent reoccurrence of injury as well as decrease time lost. Athletic trainers work with collegiate athletes for prevention and rehabilitation of injuries. Determining whether these providers are utilizing prevention, evaluations, treatments, and rehabilitation prevention programs that have been shown to reduce injury or reduce reinjury is important to ensure best practice.

CHAPTER III:

METHODS

Participants

For this research study, a survey was sent out using Qualtrics to 1,000 athletic trainers working in the collegiate setting with 46 survey responses. The participants were included in this study if they were currently working as an athletic trainer at a Division I, II, III, NAIA, and junior college schools. Athletic trainers were excluded if they did not currently work in the collegiate setting. Athletic trainers were recruited through a database from the National Athletic Trainers Association (NATA). All participation in this study was voluntary and an informed consent was signed prior to beginning the survey. This study received IRB approval prior to distributing the survey to the athletic trainers.

Instrumentation

Instructions were sent to all participants along with the survey link via the NATA database email addresses. Participants were told the purpose of the study and informed of their anonymity. The questions were answered with qualitative data from each athletic trainer at the college/university. Participants were instructed to provide accurate information to the best of their knowledge. The data collected from this survey allowed for the comparison of prevention, evaluation, treatment, and rehabilitation of hamstring injuries across different divisions to determine how the injuries are being delt with and whether PRP injections are being used.

Procedures

The NATA Research Survey Service was used to send out an email to athletic trainers currently working in a collegiate setting. An email was sent to each athletic trainers with a hyperlink to the Qualtrics survey along with an explanation of the survey and purpose. The participants were sent the survey on February 24tht, 2022 and given four weeks to respond with their data. Reminder emails were sent on March 3rd, 10th, and 17th to those who had not yet responded, and the survey closed on March 24th. They were asked to volunteer in a survey regarding hamstring strain injury prevention, evaluation, treatment, rehabilitation, and PRP injections that would take approximately 5 minutes to complete. The participants were assured anonymity in their answers to protect the information that they provided.

Survey

See Appendix D.

Data Analysis

Data analyses were performed through Statistical Package for the Social Sciences (SPSS version 20.0). Descriptive statistics were created for the variables in this study. A chi-square test of independence was conducted to determine the probability that PRP injections would be implemented more often by Division I athletic trainers than non-Division I athletic trainers. Frequency table were created to show the results from the answers to question numbers 1 and 3-13.

CHAPTER IV:

RESULTS

There were 41 participants that completed the survey and had results analyzed, 18 Division I, 4 Division II, 11 Division III, and 8 NJCAA. Results from a chi-square test of independence indicated that Division I athletic trainers were more likely to have implemented PRP injections for hamstring strain injuries than non-Division I athletic trainers. The relationship between athletic division and PRP injection usage is significant at the .05 level (x^2= 10.58, df = 2). Thus, PRP injection usage is dependent on the athletic trainer's athletic division (Figure 1).

Frequency graphs were created to show the comparison between the assessment lumbopelvic rotation, bilateral hip flexor flexibility, gluteus maximus strength, and gluteus minimus strength. Results showed that athletic trainers were likely to assess all four of these when assessing a hamstring strain injury (Figure 2).

Frequency graphs were created to show the comparison of PRP usage with all hamstring strain injuries and specifically to moderate to severe strains. Results showed that most doctors were not suggesting PRP injections for all hamstring strain injuries and moderate to severe hamstring strains (Figure 3).

Table 2

Participant's Athletic Division

	# of participants	% of participants
NCAA I	18	43.9%
NCAA II	4	9.8%
NCAA III	11	26.8%
NJCAA	8	19.5%

Figure 1

Platelet-Rich-Plasma Injection Usage Based on Athletic Division

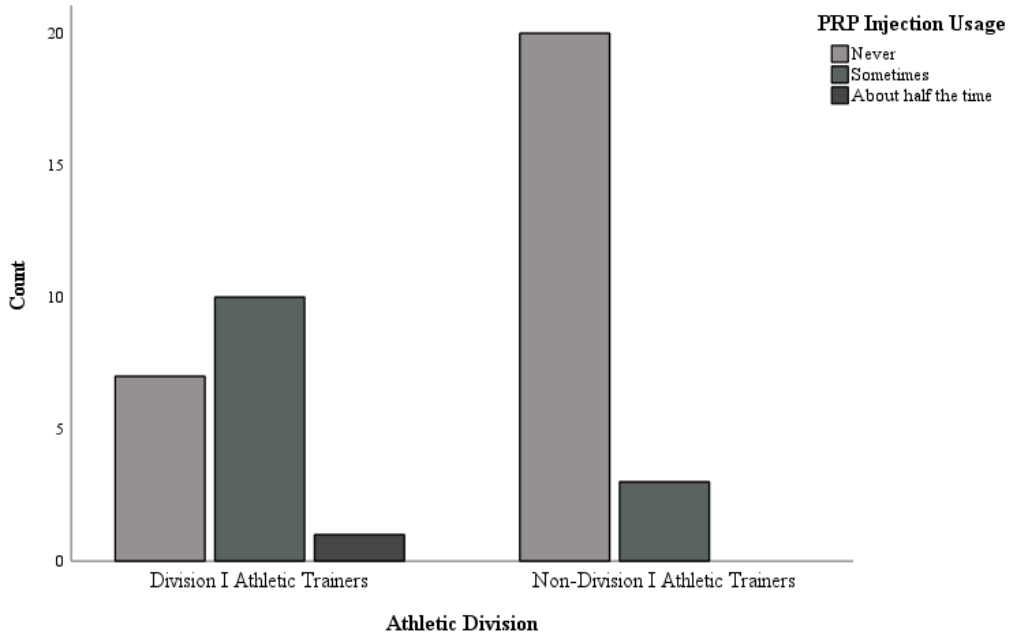
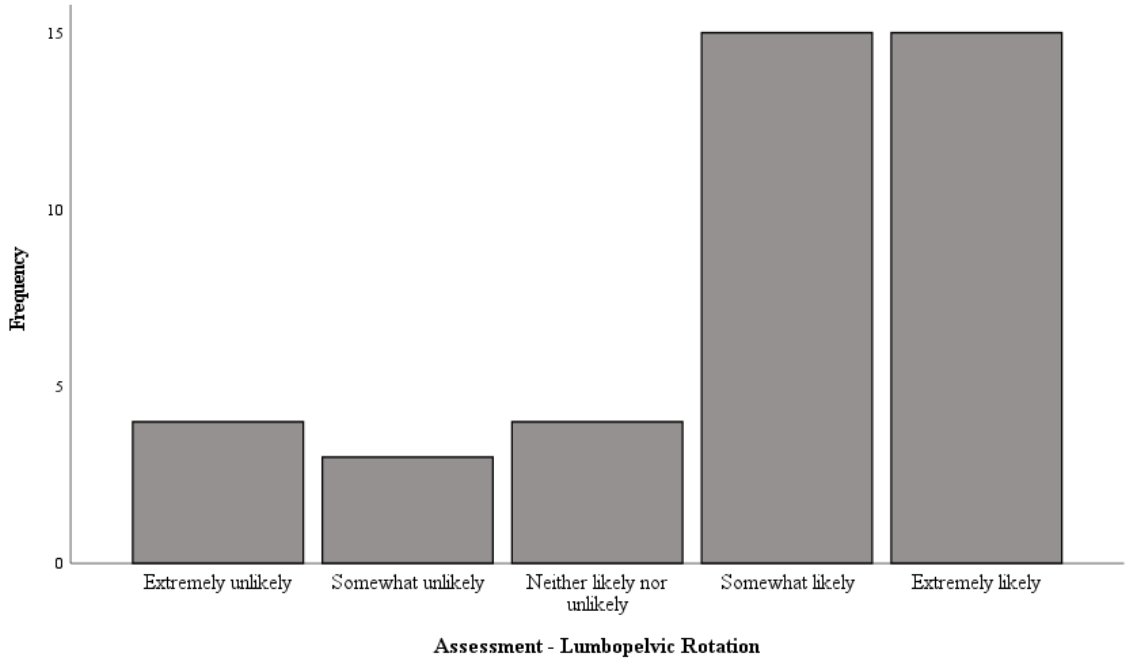


Figure 2

Assessment Type for Hasmtring Strain Injuries and Usage Frequency

A



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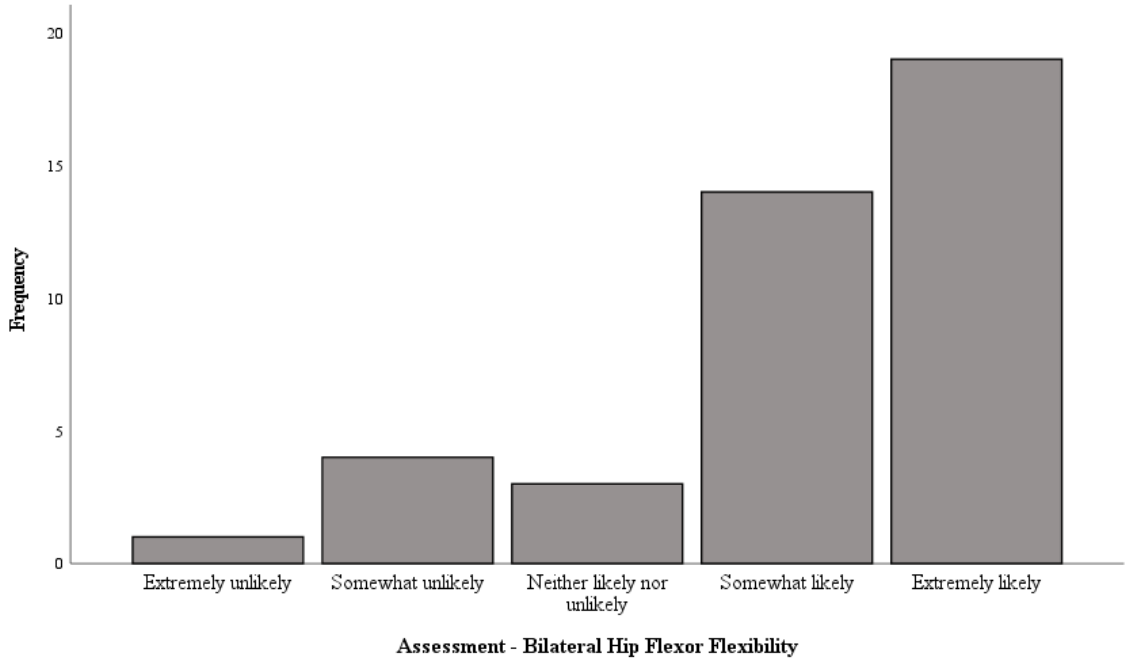
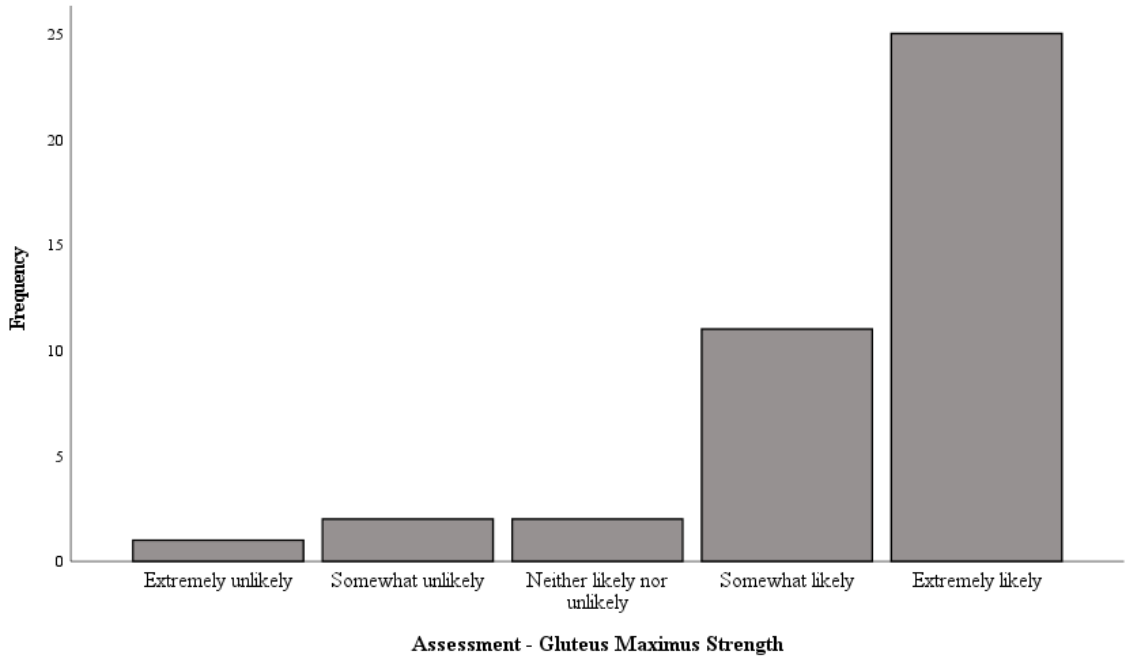


Figure 2 cont.

C



D

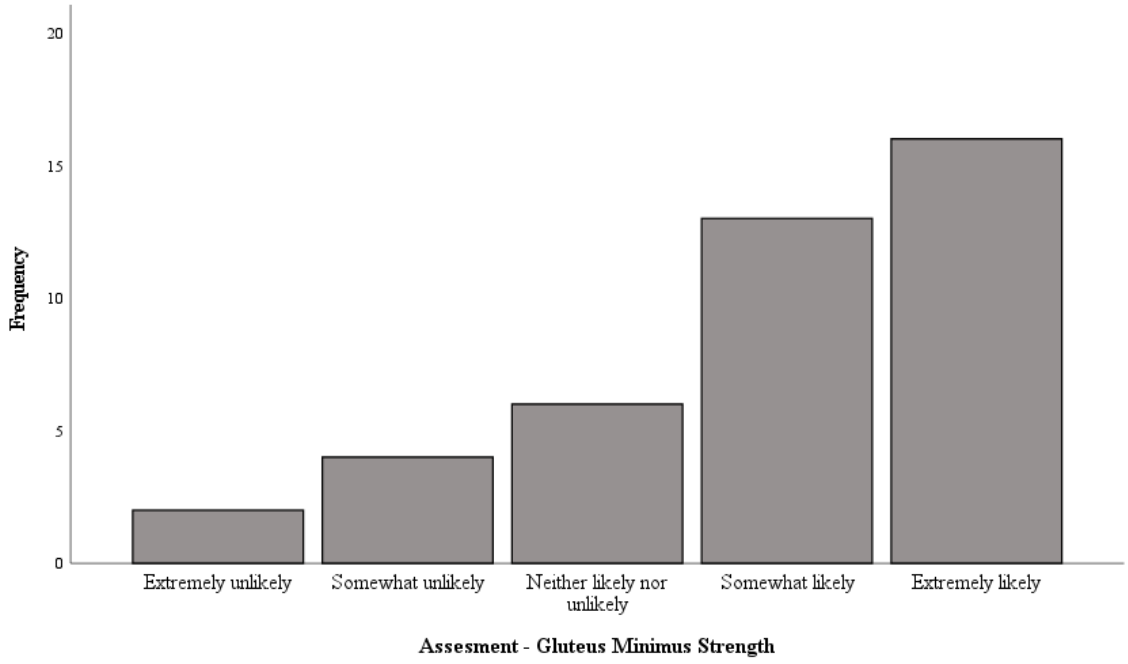
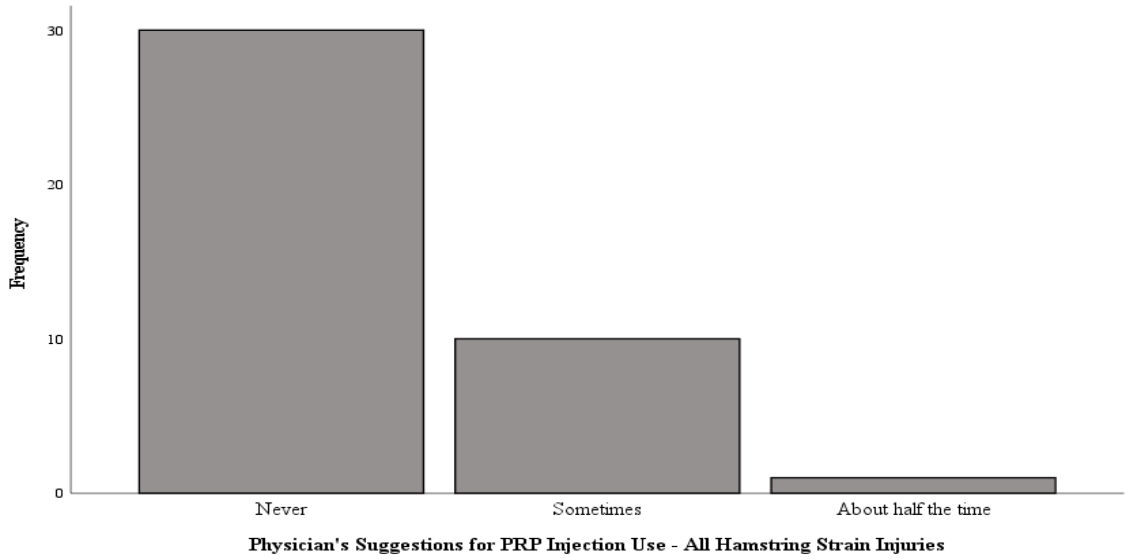


Figure 3

Physician Suggestion of PRP Injections for All HSIs and Moderate-to-Severe HSIs

A



B

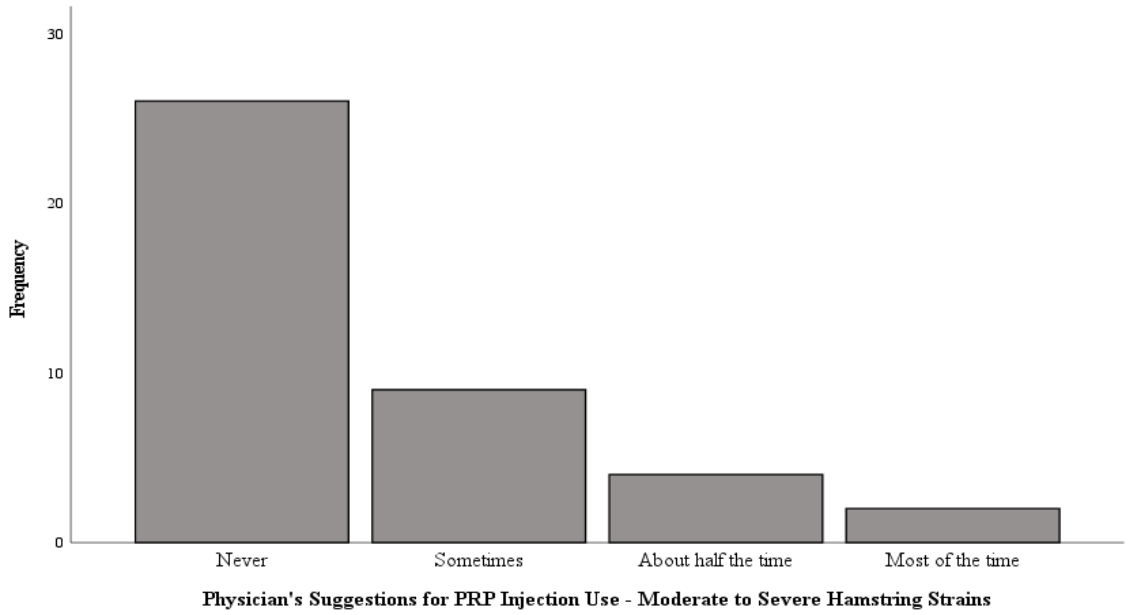


Figure 4

How often do you evaluate for hamstring injury risk?

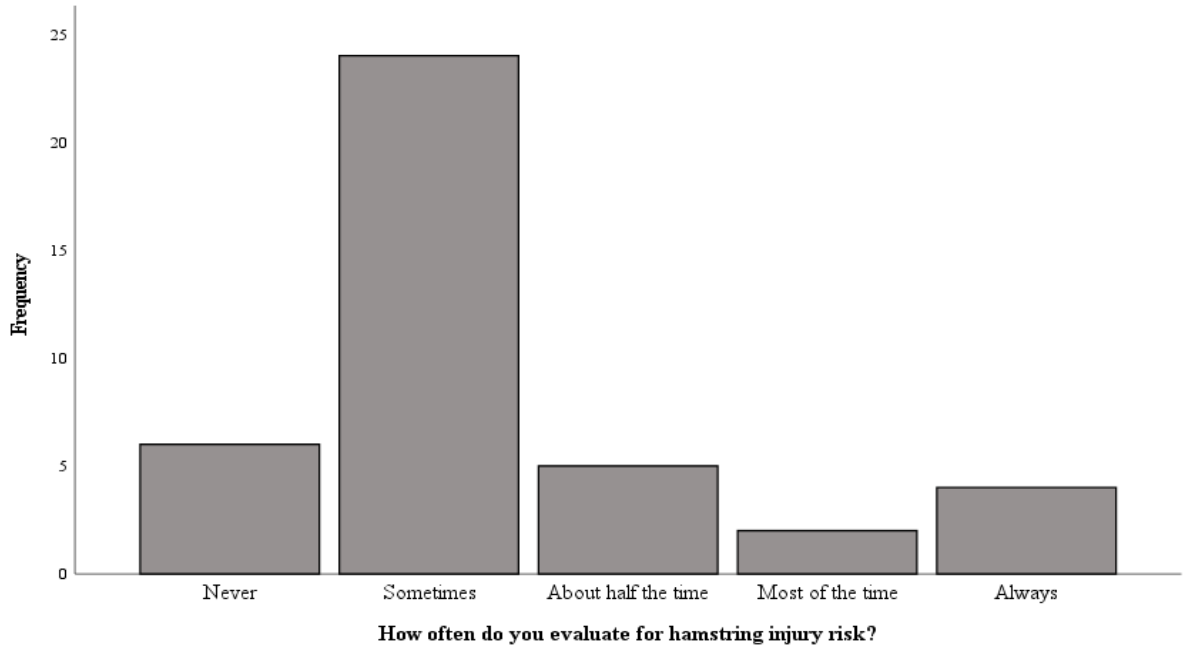


Figure 5

How effective is your current approach to finding causes/reasons for hamstring strains during your assessment?

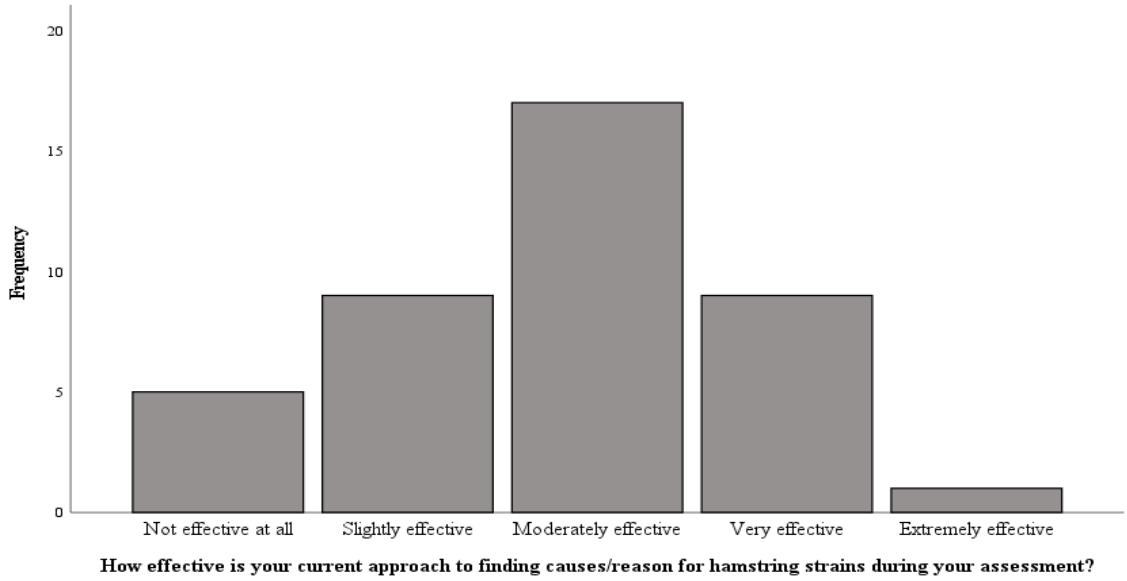


Figure 6

How likely are you to check for muscle imbalances when evaluating hamstring strain injuries?

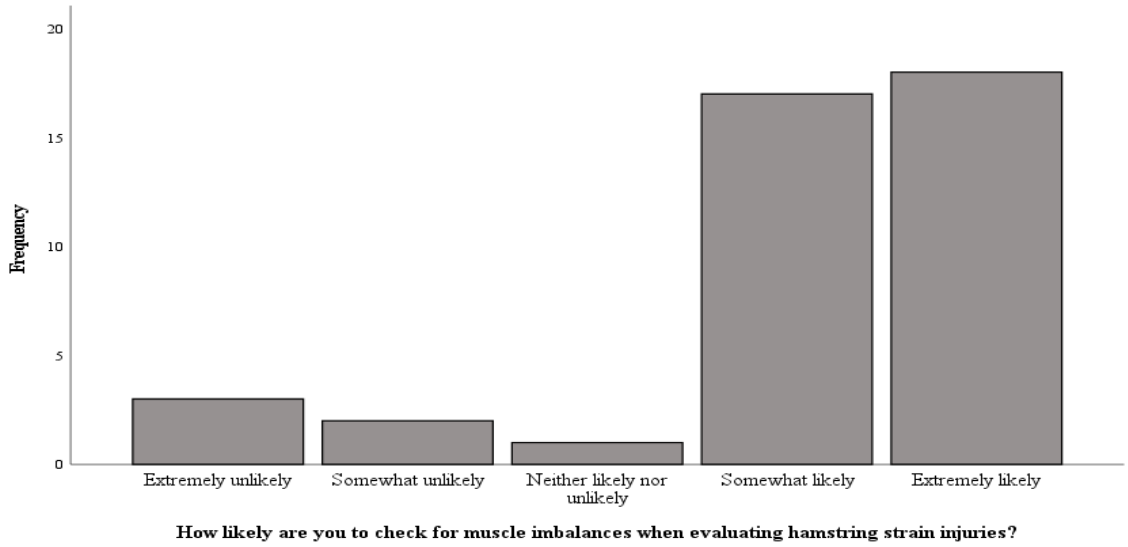


Figure 7

How often does your institution use a prevention program that is specifically for hamstring injuries?

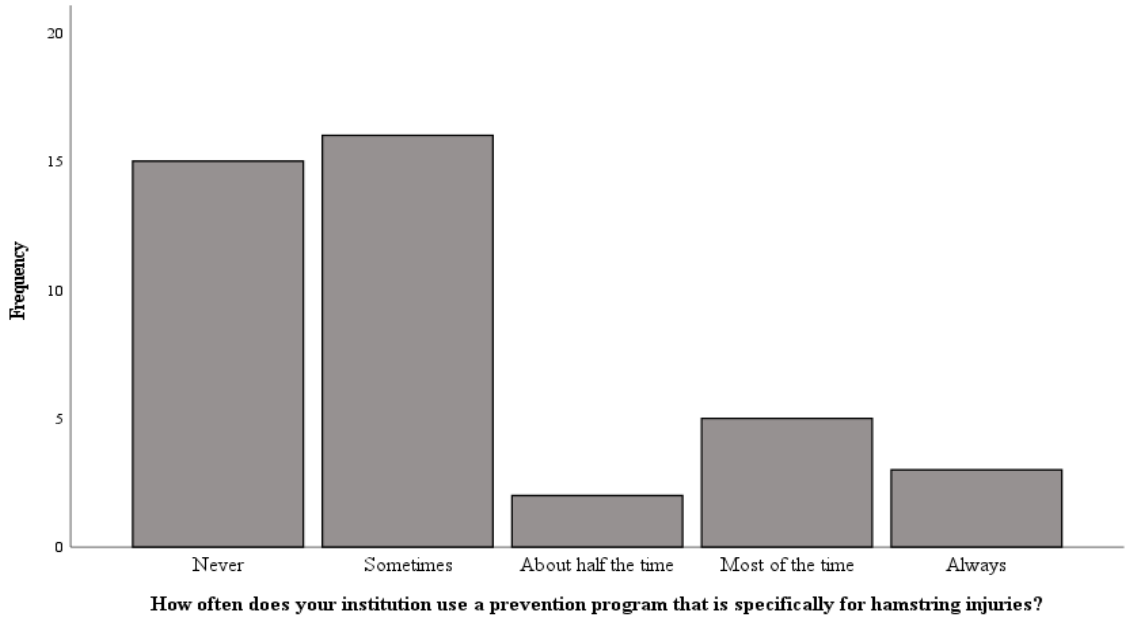


Figure 8

How effective is your current approach to treating hamstring strain injuries?

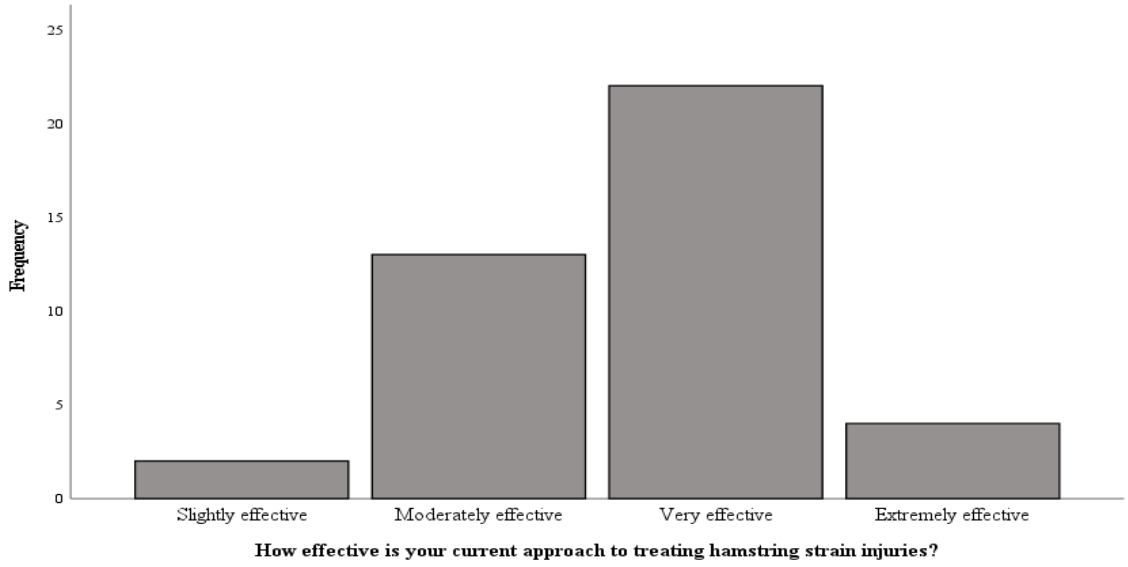
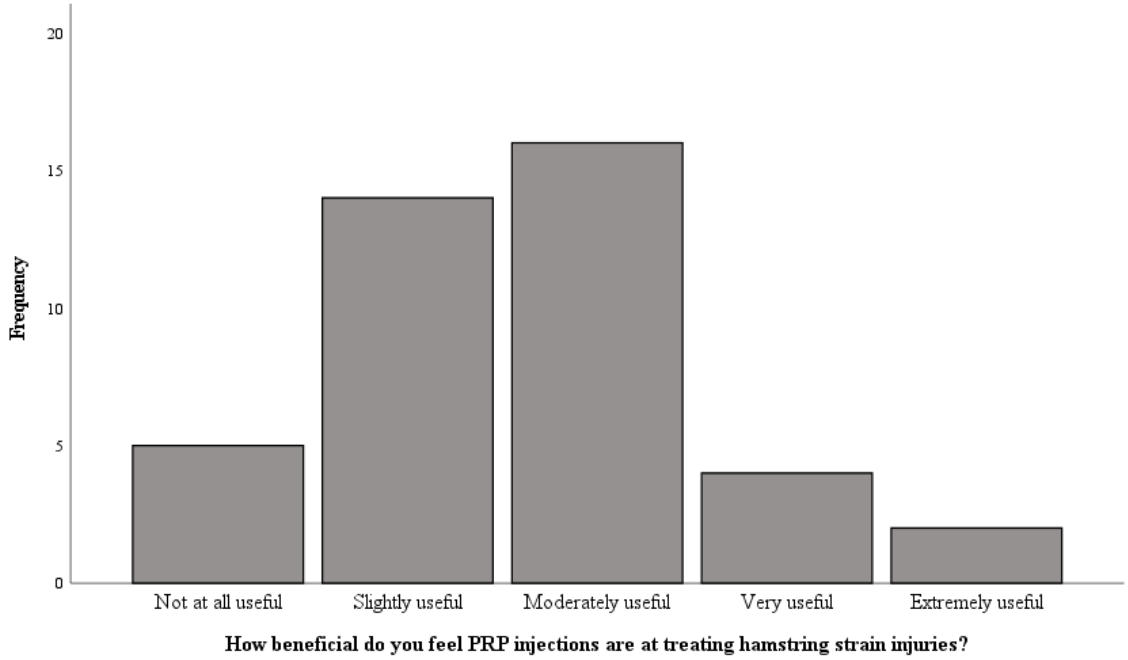


Figure 9

How beneficial do you feel PRP injections are at treating hamstring strain injuries?



CHAPTER V:

DISCUSSION

This study examined the comparison of Division I versus all other collegiate athletic trainers with the usage of PRP injections, the assessment of hamstring strain injuries, and the suggestion of PRP usage by physicians working with collegiate athletic trainers. Recently, it has beenfdetermined that PRP injections are beneficial in the reduction of reinjury rates as well as return to play time (Trunz et al., 2021). With this new research, part of the survey asked athletic trainers about PRP injections to determine if they were being used in collegiate athletics for HSIs.

Divisional differences in collegiate athletics present a large variation in the resources available to their athletes. The results of this study showed a significant difference in the usage of PRP injections in Division I versus all other collegiate athletics. Division I athletic trainers were more likely to have some usage of PRP injections when compared to all other college athletic trainers (Figure 1). While Division I athletics typically have more resources and funding than other divisions, 22% of athletic trainers chose cost and 24% chose availability as reasons for not using PRP injections. Physicians' opinion was the most selected reason with 25% of the athletic trainers selecting this as the reason PRP injections were not being used. This may be due to their physician not being up to date on research backing PRP injections, differing results with their own personal outcomes, or the physician may dislike using injections in general but also for muscular injuries. Of those surveyed, 4% indicated that PRP injections were not effective and 16% designated that treatment knowledge for use was inadequate to justify use. Regarding athletic trainers feelings about PRP injections, 12% felt they were not

useful at all, 34% felt they were slightly useful, 39% felt they were moderately useful, 10% felt they were very useful, and 5% felt they were extremely useful (Figure 9). With all this and now that there is research showing the benefits of PRP injections for hamstring strains, it is important for not only physicians to be up to date on the research, as they would be the provider to prescribe the injection, but athletic trainers so they can advocate for the best treatment for their athletes.

PRP injections are typically used in grade II or higher hamstring strains due to the amount of damage to the muscle and many research studies have used grade II strains to determine their patient populations (Bezuglov et al., 2019; Park et al., 2019; Zanon et al., 2016). When athletic trainers were asked about PRP suggestions by physicians for use in HSIs, results showed that physicians were typically not suggesting PRP injections for either all hamstring strains or moderate-to-severe hamstring strains (Figure 3). In all hamstring strains, 73% of athletic trainers said their physicians never suggested PRP injections and in moderate-severe HSIs there were 63%. While most athletic trainers are not sending minor hamstring strains to see a physician, moderate-to-severe strains are more likely to be seen by a physician and results from this study showed that some athletic trainers felt their physicians were more likely to suggest the PRP injection for those with a more significant HSI. While PRP injections may be used slightly more for moderate-to-severe HSIs, the importance of this study shows they are rarely being used on any HSI.

When assessing the evaluations being performed by athletic trainers, hamstring strain injuries, lumbopelvic rotation, bilateral hip flexor flexibility, gluteus maximus strength, and gluteus minimus strength were all shown to be used often among athletic

trainers when assessing for HSIs (Figure 2 A-D). Regarding assessment for muscle imbalances in general for HSIs, 44% of athletic trainers reported to be extremely likely to assess and 41% reported being somewhat likely (Figure 6). A comprehensive evaluation of HSIs allows for the athletic trainer to treat and rehabilitate the athlete with a focus on reduction of risks that could have contributed to the original injury. Although it was not hypothesized, this study revealed that athletic trainer's felt their current treatment approach was moderate (33%) to very (52%) effective, while 10% felt theirs was extremely effective. Athletic trainers reported for at least half the time or more using eccentric exercises (95%), conventional resistance exercises (98%), stretching (83%), myofascial release (93%), and core training (93%) when rehabilitating a HSI. These rehabilitative components help to reduce altered reciprocal inhibition and synergistic dominance as well as any modifiable risk factors contributing to injury.

When asked about the effectiveness of their current approach to HSI treatment, 0% reported being not effective at all, 5% reported being slightly effective, 33% reported being moderately effective, 52% reported being very effective, and 10% reported being extremely effective (Figure 8). With these results in mind, many athletic trainers seem to feel that they could have a better approach to the treatment of HSIs, but none felt they weren't being effective at all. When asked about their current approach to finding the cause or reason for HSIs during their evaluations, results showed that 12% of athletic trainers reported being not effective at all, 21% reported being slightly effective, 43% reported being moderately effective, 21% reported being very effective and 2% reported being extremely effective (Figure 5). Athletic trainers seem to feel more effective with their treatments rather than finding the cause of the injury for HSIs. This could be due to

some athletic trainers not evaluating the cause of injury and just determining the injury, having multiple causes that they cannot determine which was the true cause, and they may feel more confident in their treatments rather than their assessments. Future research could assess this to determine why athletic trainers feel more effective in their treatments rather than assessment for the cause of injury.

Regarding assessments, 60% of athletic trainers reported only sometimes checking for hamstring injury risk, while 14% never checked for hamstring injury risk, and only 10% always checked for hamstring risk (Figure 4). This could partially be due to resources available at differing athletic divisions with some institutions only having one athletic trainer for many sports. An early recognition of risk factors for HSIs can allow for a prevention program to be established to reduce risks and ultimately reducing time lost due to injury. Prevention programs were shown to be never used by 38% of institutions, sometimes by 38%, half the time by 5%, most of the time by 12%, and always by 7% (Figure 7). Prevention programs can be coordinated and implemented by a multitude of areas within the institutions athletics department, including strength and conditioning staff, sports medicine staff, and coaching staff. These prevention programs should be used more often used as their use may produce positive effects towards reducing HSIs.

Combining a proper evaluation for risk factors that could have led to the injury along with addressing them through the rehabilitation. When implementing a prevention program, addressing the risk factors found in an evaluation can be done using the same rehabilitation techniques. Suarez-Arrones et al. (2021) found that a multicomponent prevention program including the rehabilitative methods being used by athletic trainers

can help prevent HSIs and reinjury. With this survey being sent out to athletic trainers, they may have reported utilizing some of the evaluation and treatment options more frequently than they typically use them. This could be due to the athletic trainers reporting values of what they feel they should be doing or have done previously but is not an accurate current representation.

Athletic trainers seem to be evaluating athletes for the risk factors and addressing them in rehabilitation, but the lack of PRP use may show a lack of an important treatment option being utilized. This may be due to athletic trainers and physicians not being up to date on current research. Another reason may be due to the opinion of the physicians and athletic trainers about injections into a muscle. Some prefer to not inject into muscles due the adverse effects that could occur. Physicians and athletic trainers need to be aware of this treatment option and the benefits that it brings to athletes with HSIs. Athletic trainers should be advocating for the best available treatments for their athletes and therefore need to be up to date on the current research regarding PRP injections and HSIs.

Conclusion

This study highlighted the importance of reducing HSIs and the risk of reinjury due to the frequency of injury to the hamstring muscle group. While there are many different evaluation, treatment, and rehabilitative options available, there remains a high number of HSIs and reinjuries. Athletic trainers are evaluating athletes for HSIs while assessing risk factors through evaluation of lumbopelvic rotation, bilateral hip flexor flexibility, gluteus maximus strength, and gluteus minimus strength. Evaluation of HSIs by collegiate athletic trainers has shown to be following current research. As for treatment options, Platelet-rich-plasma injections are a newer option available to use as

treatment for HSIs and has recently showed a significant decrease in the reinjury rates. This study found that PRP injections are not being used often in collegiate athletics for HSIs. As for rehabilitation aspect, athletic trainers showed that they were using options backed by research as well including eccentric exercises, conventional resistance exercises, stretching, myofascial release, and core training. From the results of this study, there seems to be a lack of PRP injection usage in collegiate athletics and a shift to an increased usage may allow for a reduction of reinjury risk to these athletes.

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APPENDICES

APPENDIX A

Informed Consent Form

Information and Disclosure Section

The following information is provided to inform you about the research project in which you have been invited to participate. Please read this disclosure and feel free to ask any questions. The investigators must answer all of your questions and please save this page as a PDF for future reference.

- Your participation in this research study is voluntary.
- You are also free to withdraw from this study at any time without loss of any benefits.

For additional information on your rights as a participant in this study, please contact the Middle Tennessee State University (MTSU) Office of Compliance (Tel 615-494-8918 or send your emails to irb_information@mtsu.edu. (URL: http://www.mtsu.edu/irb).

Please read the following and respond to the consent questions in the bottom if you wish to enroll in this study.

1. **Purpose**: This research project is designed to help us evaluate. The purpose of this study is to explore the evaluation and treatment methods being used by collegiate athletic trainers for hamstring strain injuries to reduce the risk of reinjury and to determine whether platelet-rich-plasma injections are being used as a method of treatment.

2. **Description**: This project consists of a 13 question survey through Qualtrics.

3. **IRB Approval Details**
   - Protocol Title: **Platelet-Rich Plasma Injections and Collegiate Athletic Trainer's Prevention, Evaluation, Treatment, and Rehabilitation for Hamstring Injuries**
   - Primary Investigator: Chelsea Berghorn, LAT, ATC, CSCS
   - PI Department & College: Health and Human Performance Sciences; College of Behavioral and Health Sciences
   - Faculty Advisor (if PI is a student): Dr. John Coons
   - Protocol ID: 22-1102 2q_ Approval Date: _02/18/2022_ Expiration Date: _02/28/2023_

4. **Duration**: The duration of the survey should take 5-8 minutes.

5. **Here are your rights as a participant:**
    - Your participation in this research is voluntary.
    - You may skip any item that you don't want to answer, and you may stop the experiment at any time (but see the note below)
    - If you leave an item blank by either not clicking or entering a response, you may be warned that you missed one, just in case it was an accident. But you can continue the study without entering a response if you didn't want to answer any questions.
    - Some items may require a response to accurately present the survey.

6. **Risks & Discomforts: There are no risks/discomforts for participants.**

7. **Benefits:**
    a. Benefits to you that you may not receive outside this research: There are no direct benefits to you but the results of this study may help benefit athletic trainers and athletes in the collegiate setting dealing with hamstring strain injuries.
    b. Benefits to the field of science or the community: This study can help identify where weaknesses/strengths may be in regard to the prevention, evaluation, treatment, and rehabilitation of hamstring injuries in collegiate athletics. This study will help determine whether collegiate athletic trainers are keeping up with the research for best practice with hamstring injuries. This study will also benefit research for PRP injections which have not been vastly researched in collegiate athletics for hamstring injuries.

8. **Identifiable Information**: You will NOT be asked to provide identifiable personal information/You may provide contact information for follow-up / We may request your contact information for compensation purposes

9. **Compensation: There is no compensation for participating in this study**

10. **Confidentiality.** All efforts, within reason, will be made to keep your personal information private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, *if* you or someone else is in danger or if we are required to do so by law.

11. **Contact Information.** If you should have any questions about this research study or possibly injury, please feel free to contact Chelsea Berghorn, LAT, ATC, CSCS by telephone 423-599-3742 or by email crb8y@mtmail.mtsu.edu OR my faculty advisor, Dr. John Coons, at john.coons@mtsu.edu. You can also contact the MTSU Office of compliance via telephone (615 494 8918) or by email

(compliance@mtsu.edu). This contact information will be presented again at the end of the experiment.

You are not required to do anything further if you decide not to enroll in this study. Just quit your browser. Please complete the response section below if you wish to learn more or you wish to part take in this study.

Participant Response Section

☐No ☐Yes I have read this informed consent document pertaining to the above identified research
☐No ☐Yes The research procedures to be conducted are clear to me
☐No ☐Yes I confirm I am 18 years or older
☐No ☐Yes I am aware of the potential risks of the study

By clicking below, I affirm that I freely and voluntarily choose to participate in this study. I understand I can withdraw from this study at any time without facing any consequences.

☐ NO I do not consent
☐ Yes I consent

APPENDIX B

University Institutional Review Board Approval

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129
FWA: 00005331/IRB Regn.. 0003571

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN007 – EXEMPTION DETERMINATION NOTICE

Friday, February 18, 2022

Protocol Title	***Platelet-Rich Plasma Injections and Collegiate Athletic Trainer's Prevention, Evaluation, Treatment, and Rehabilitation for Hamstring Injuries***
Protocol ID	**22-1102 2q**
Principal Investigator	**Chelsea Berghorn** (Student) *Faculty Advisor:* John Coons
Co-Investigators	Sandra Stevens
Investigator Email(s)	*crb8y@mtmail.mtsu.edu; john.coons@mtsu.edu*
Department/Affiliation	Health and Human Performance

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category ***(2) Educational Tests, surveys, interviews or observations of public behavior*** *(Qualtrics Survey).* A summary of the IRB action and other particulars of this protocol are shown below:

IRB Action	**EXEMPT from further IRB Review** Exempt from further continuing review but other oversight requirements apply
Date of Expiration	**2/28/2023** *Date of Approval:* **2/18/22** *Recent Amendment:* **NONE**
Sample Size	ONE THOUSAND (1,000)
Participant Pool	**Healthy adults (18 or older) – Athletic Trainers**
Exceptions	Online consent followed by internet-based survey using Qualtrics is permitted (Qualtrics links on file).
Type of Interaction	☐ Non-interventional or Data Analysis ☐ Virtual/Remote/Online Interview/survey ☐ In person or physical– Mandatory COVID-19 Management (refer next page)
Mandatory Restrictions	**1. All restrictions for exemption apply.** **2. The participants must be 18 years or older.** **3. Mandatory ACTIVE informed consent.** **4. Identifiable information, such as, names, addresses, and voice/video data, must not be obtained.** **5. NOT approved for in-person data collection.**
Approved IRB Templates	*IRB Templates:* Online Informed Consent *Non-MTSU Templates:* Recruitment Email
Research Inducement	NONE
Comments	NONE

Summary of the Post-approval Requirements: The PI and FA must read and abide by the post-approval conditions (Refer "*Quick Links*" in the bottom):

- ***Final Report:*** The Faculty Advisor (FA) is responsible for submitting a final report to close-out this protocol before **2/28/2023**; if more time is needed to complete the data collection, the FA must request an extension by email. REMINDERS WILL NOT BE SENT. **Failure to close-out (or request extension) may result in penalties** including cancellation of the data collected using this protocol or withholding student diploma.
- ***Protocol Amendments***: IRB approval must be obtained for all types of amendments, such as:
  - Addition/removal of subject population and sample size.
  - Change in investigators.
  - Changes to the research sites – appropriate permission letter(s) from may be needed.
  - Alternation to funding.
  - Amendments must be clearly described in an addendum request form submitted by the FA.
  - The proposed change must be consistent with the approved protocol and they must comply with exemption requirements.
- ***Reporting Adverse Events:*** Research-related injuries to the participants and other events , such as, deviations & misconduct, must be reported within 48 hours of such events to compliance@mtsu.edu.
- ***Research Participant Compensation:*** Compensation for research participation must be awarded as proposed in Chapter 6 of the Exempt protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office.
- ***COVID-19:*** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

COVID-19 Management:
The FA must enforce social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

- The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."
- The FA must enforce the MTSU's "Return-to-work" questionnaire found in Pipeline must be filled and signed by the investigators on the day of the research interaction prior to physical contact.
- PPE must be worn if the participant would be within 6 feet from the each other or with an investigator.
- Physical surfaces that will come in contact with the participants must be sanitized between use
- **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the PI will be instructed to carryout remedial measures if needed.

Post-approval Protocol Amendments:
The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would not result in the cancellation of the protocol's eligibility for exemption. ***Only THREE procedural amendments will be entertained per year*** *(changes like addition/removal of research personnel are not restricted by this rule).*

Date	Amendment(s)	IRB Comments
NONE	NONE.	NONE

Post-approval IRB Actions:
The following actions are done subsequent to the approval of this protocol on request by the PI or on recommendation by the IRB or by both.

Date	IRB Action(s)	IRB Comments
NONE	NONE.	NONE

Mandatory Data Storage Requirement:
All research-related records (signed consent forms, investigator training and etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data must be stored for at least three (3) years after the study is closed. Additionally,

the Tennessee State data retention requirement may apply (*refer "Quick Links" below for policy 129*). Subsequently, the data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects. **The IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this notice**. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

- Post-approval Responsibilities: http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php
- Exemption Procedures: https://mtsu.edu/irb/ExemptPaperWork.php
- MTSU Policy 129: Records retention & Disposal: https://www.mtsu.edu/policies/general/129.php

APPENDIX C

Participation Request Email

Name,

This email invites you to participate in a research study titled "Platelet-Rich Plasma Injections and Collegiate Athletic Trainer's Prevention, Evaluation, Treatment, and Rehabilitation for Hamstring Injuries". The purpose of this study is to assess the prevention, evaluation, treatment, and rehabilitation methods being used by collegiate athletic trainers for hamstring strain injuries to reduce risk of reinjury and to determine whether platelet-rich-plasma injections are being used as a method of treatment.

You have been selected as a possible participant for this study because you are an athletic trainer in good standing with the National Athletic Trainers' Association and practicing in the college or university setting. Your participation in this study requires the completion of a one-time voluntary survey that will take ~ 5 minutes to complete. The link to complete the survey is included below. Your participation in this study is voluntary and you may choose to discontinue your participation at any point. This study was granted approval by the Institutional Review Board. All data collected is confidential and there are minimal risks if you choose to participate. Please refer below for IRB details for this project.

- Protocol Title: **Platelet-Rich Plasma Injections and Collegiate Athletic Trainer's Prevention, Evaluation, Treatment, and Rehabilitation for Hamstring Injuries**
- Primary Investigator: Chelsea Berghorn, LAT, ATC, CSCS
- PI Department & College: Health and Human Performance Sciences; College of Behavioral and Health Sciences
- Faculty Advisor (if PI is a student): Dr. John Coons
- Protocol ID: 22-1102 2q Approval Date: 02/18/2022 Expiration Date: 02/28/2023

There are no direct benefits to you for participation in this study, but information collected through this study can help benefit the athletic training profession and the athletes who are working with collegiate athletic trainers. There are no costs to you for

participating in the study. The information you provide will be used to inform the researcher, the institution, and the profession about the prevention, evaluation, treatment, and rehabilitation methods being used by collegiate athletic trainers for hamstring strain injuries. Your participation would be greatly appreciated.

Follow this link to the Survey:

Or copy and paste the URL below into your internet browser:
https://mtsu.ca1.qualtrics.com/jfe/form/SV_0IkZln4HOS31BS6

If you have any questions about the study, please contact Chelsea Berghorn by email at crb8y@mtmail.mtsu.edu or Dr. John Coons by email at john.coons@mtsu.edu.

If you have any questions concerning your rights as a research participant in this study, you may contact the Middle Tennessee State University Institutional Review Board (IRB) at irb_information@mtsu.edu.

Thank you ,

Chelsea Berghorn, LAT, ATC, CSCS
Graduate Assistant Athletic Trainer (*Football)*
Middle Tennessee State University
crb8y@mtmail.mtsu.edu

Participants for this survey were selected at random from the NATA membership database according to the selection criteria provided by the Primary Investigator performing the study. This research survey is not approved or endorsed by NATA. It is being sent to you because of NATA's commitment to athletic training education and research.

APPENDIX D

Survey

I have read this informed consent document pertaining to the above identified research

- ○ Yes (1)
- ○ No (4)

The research procedures to be conducted are clear to me

- ○ Yes (1)
- ○ No (2)

I confirm I am 18 years or older

- ○ Yes (1)
- ○ No (2)

I am aware of the potential risks of the study

- ○ Yes (1)
- ○ No (2)

By clicking below, I affirm that I freely and voluntarily choose to participate in this study. I understand I can withdraw from this study at any time without facing any consequences.

- ○ No, I do not consent (1)
- ○ Yes, I consent (2)

Q1 What division of collegiate athletics do you work in?

- ○ NCAA I (1)
- ○ NCAA II (2)
- ○ NCAA III (3)
- ○ NAIA (4)
- ○ NJCAA (5)

Q2 Which sport or sports do you cover? (check all that apply and add any others that are not listed)

- ☐ Football (1)
- ☐ Soccer (2)
- ☐ Lacrosse (3)
- ☐ Track and Field / Cross Country (4)
- ☐ Softball/Baseball (5)
- ☐ Basketball (6)
- ☐ Volleyball (7)
- ☐ Other (8) _____

Page Break

Q3 How often do you evaluate for hamstring injury risk?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q4 How often does your institution use a prevention program that is specifically for hamstring injuries?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q5 How effective is your current approach to finding causes/reason for hamstring strains during your assessment?

- ○ Not effective at all (1)
- ○ Slightly effective (2)
- ○ Moderately effective (3)
- ○ Very effective (4)
- ○ Extremely effective (5)

Q6 How effective is your current approach to treating hamstring strain injuries?

- ○ Not effective at all (1)
- ○ Slightly effective (2)
- ○ Moderately effective (3)
- ○ Very effective (4)
- ○ Extremely effective (5)

Page Break

Q7 How likely are you to check for muscle imbalances when evaluating hamstring strain injuries?

- ○ Extremely unlikely (1)
- ○ Somewhat unlikely (2)
- ○ Neither likely nor unlikely (3)
- ○ Somewhat likely (4)
- ○ Extremely likely (5)

Q8 How often do you assess the following when assessing hamstring strain injuries?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Lumbopelvic rotation (1)	○	○	○	○	○
Bilateral hip flexor flexibility (2)	○	○	○	○	○
Gluteus maximus strength (3)	○	○	○	○	○
Gluteus minimus strength (4)	○	○	○	○	○

Q9 How often are each of the following used for treatment/rehabilitation of a hamstring strain with your athletes?

	Never (1)	Sometimes (2)	About half the time (3)	Most of the time (4)	Always (5)
PRP injection(s) (1)	○	○	○	○	○
Cortisone injection(s) (2)	○	○	○	○	○
Eccentric exercises (3)	○	○	○	○	○
Conventional resistance exercises (4)	○	○	○	○	○
Stretching (5)	○	○	○	○	○
Myofascial release (including self-myofascial release) (6)	○	○	○	○	○
Core training (including abdominal and lower back exercises) (7)	○	○	○	○	○

Page Break

Q10 How often do your physicians suggest PRP injections for all hamstring strain injuries

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q11 How often do your physicians suggest PRP injections for moderate to severe hamstring strains?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q12 If PRP injections are not often used, what are the reasons for that? (check all that apply)

- ☐ Cost (1)
- ☐ Availability (2)
- ☐ Physicians' opinion (3)
- ☐ Not effective (4)
- ☐ Treatment knowledge is inadequate to justify using (5)
- ☐ Other (6) _____

Q13 How beneficial do you feel PRP injections are at treating hamstring strain injuries?

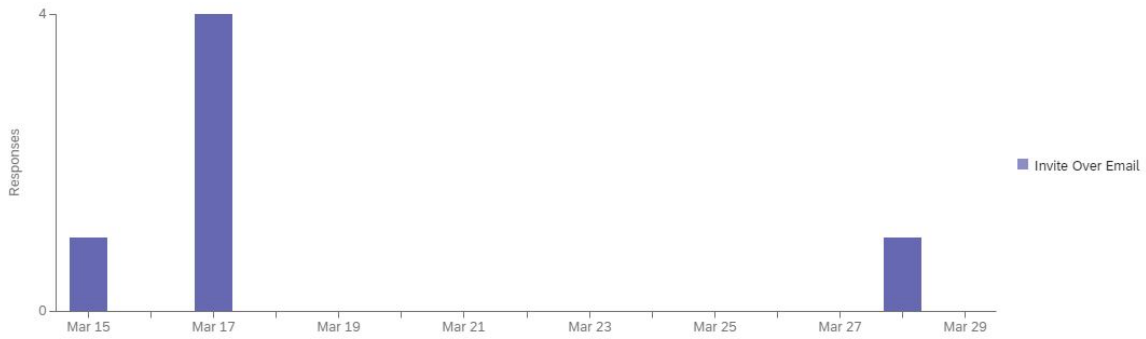
- ○ Not at all useful (1)
- ○ Slightly useful (2)
- ○ Moderately useful (3)
- ○ Very useful (4)
- ○ Extremely useful (5)

End of Block: Survey Questions

APPENDIX E

Distribution Reports

Recent Responses



All Responses

Distribution Channel	Audience Size	Surveys started	Responses	Completion Rate
Invite Over Email	**1000**	**54**	**47**	**87%**