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Improving the Active Straight Leg Raise by Active and Passive Partner Assisted Stretching

Cortney R. Payne
The University of Texas Rio Grande Valley

IMPROVING THE ACTIVE STRAIGHT LEG RAISE

BY ACTIVE AND PASSIVE PARTNER

ASSISTED STRETCHING

A Thesis

by

CORTNEY R. PAYNE

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COMMITTEE MEMBERS

Dr. Philip Conatser
Chair of Committee

Dr. Zasha Romero
Committee Member

Dr. Zelma Mata
Committee Member

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ABSTRACT

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The Functional Movement Screen has been a very popular tool for assessing athlete's movements and predicting future risk of injury. In the hierarchy of this screen, the active straight leg raise reigns supreme. They have shown that improvements in this movement correlate to improvements in other movements but not vise versa. It is important to find a way to quickly improve this functional movement, so it can be utilized in group settings to help potentially reduce the risk of injury in athletes. The study investigated two ways of improving the active straight leg raise, a partner assisted passive stretch and an active stretch. When analyzed against the control group both stretch groups showed statistically significant improvements in the active straight leg raise. When both stretch groups were analyzed against each other, it was shown that there was no significant difference between the two.

DEDICATION

I would like to dedicate to my mother, Diane Coston Payne. Growing up she was such an inspiration to me. She always believed in me and pushed me to strive to accomplish more in school. It has taken me many years to realize that she truly saw my potential and wanted the best for me. We had many arguments and disagreements when she would push me to be better in the classroom. I finally see what she was trying to teach me. If I worked hard, I would be able to achieve many goals.

I would also like to dedicate this to my beautiful wife, Rachel Elena Ann Payne. Without her support, none of this would have been possible. She has been my driving force and my support system when I felt stressed or overwhelmed. I would like to acknowledge my family as well. Without their support, growing up and even throughout this process, it would not be possible.

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CHAPTER I

INTRODUCTION

The following information contains a review of literature that addresses the active straight leg raise, how this movement is performed, ways to improve this movement, and the importance of this movement as an assessment. The active straight leg raise is a functional movement that is used to assess both the flexibility and the motor control of the hip and knee joint. When performing the active straight leg raise, the individual needs both adequate flexibility and proper motor control. The active straight leg raise is a movement that is one of the two foundations of the Functional Movement Screen. This basic assessment of hip function plays an integral part in a system called the Functional Movement Screen. The Functional Movement Screen is a selection of movements that assesses motor control and flexibility. By improving the active straight leg raise, and therefore improving the Functional Movement Screen score, an individual's risk for injury has been shown to decrease (Shojaedin, 2014). The Functional Movement Screen is an assessment tool that is used by many professionals in the realm of performance, rehabilitation, and research purposes. There have been connections made between a poor score on the screen and an increased risk for injury. When ranking the hierarchy of the movement screens in the assessment, the Active Straight Leg Raise is at the top (Cook et al., 2014). This movement plays such an important role because it assesses hip, leg and lower leg stability and flexibility at a basic and fundamental level. Without proper control during this assessment, the individual being tested can be expected to perform poorly on the other assessments, such as the Inline Lunge, Hurdle Step and Overhead Squat. It has also been shown that improvements in this particular movement carries over to more dynamic movements in the Functional Movement Screens. Initially to improve the active straight leg raise, an individual will need to improve their flexibility and range of motion in hip flexion and hip extension contractually (Cook et al., 2014). Proprioceptive Neuromuscular Facilitation has been shown to be very effective and is utilized in both clinical and sports performance settings to improve range of motion (Westwater, Adams, & Kerry, 2010). There are several different ways to utilize this mechanism. The two most popular are agonist contract-relax and contract-relax (Sharman & Cresswell, 2006). Flexibility only addresses one of the areas that impacts motion. Motor control plays a large role in an individual's ability to move well (Cook et al., 2014).

Having described the importance of this movement, finding the most effective way to improve the active straight leg raise could be beneficial in both rehabilitative and performance settings. In a performance setting where there is one strength coach and a large group of athletes, time is always a factor. Coming up with the most effective way to improve the active straight leg raise in the shortest amount of time could be extremely advantageous to sports performance and injury prevention. The purpose of this literature is to accumulate information regarding theses specific topics and obtain a better understanding of the active straight leg raise, motor control and proprioceptive neuromuscular facilitation. The following sections will cover the Functional Movement Screen, the Active Straight Leg Raise Test, specific types of stretching, motor control and proprioceptive neuromuscular facilitation.

Statement of Problem

Lower body injuries are unfortunately a part of sport performance, which occurs to often. Recent studies have used the Active Straight Leg Raise Test and the Functional Movement

Screen to help predict the likelihood of an individual attaining one of these injuries (Warren, Smith, & Chimera 2015). Analyzation of this data shows that individuals who perform poorly on the Active Straight Leg Raise Assessment have a much higher probability to obtaining a lower body injury during the season (Shojaedin et all 2014). In 2014, injuries cost Major League Baseball teams over one billion dollars (Whiteley 2016). Finding an effective way to address and improve poor scores on the Active Straight Leg Raise Test could potentially have a positive impact on the health of the lower body of athletes and the financial costs to sports at all levels.

Statement of Purpose

The purpose of this research is to look at two different ways in which to improve the Active Straight Leg Raise Assessment. One of which is a partner assisted stretch where a therapist or strength coach is needed. The other is an active stretch which can be implemented in a group setting. If the active stretch yields similar or better results than the partner assisted stretch, this information can be taken and applied to team and group fitness settings. This way, the coach or therapist can affect the outcome of the assessment in a larger capacity.

From anecdotal observation, the improvements in the active straight leg raise will be similar in both groups. These gains will be in relation to the amount of time spent in the stretch.

The research questions addressed were:

1. Will utilizing assisted passive or active straight leg stretch improve an individual's Active Straight Leg Raise Assessment?
2. Is there a distinction as to which is more effective at improving the active straight leg raise?

Delimitation of the study

1. The number of subjects used was low which limited the generalization of the findings.
2. The subject group was not specific enough to recommend this for a specialized group, such as college athletes, middle-aged adults, etc.

CHAPTER II

REVIEW OF LITERATURE

Functional Movement Screen Assessment

With the National Collegiate Athletic Association Injury Surveillance System Program reporting over 11,000 injuries a year in college athletics alone, assessing and recognizing dysfunctional movement patterns and implementing the appropriate correctives is imperative to diminishing this number (Warren, Smith, & Chimera, 2015). The Functional Movement Screen (FMS) is a tool that assesses an individual's ability to move through space, it is also indicative of increased injury risk and inefficient movement that can reduce performance level. These basic functional movements, such as the overhead squat, inline lunge, and core stability push up, were selected and prioritized to help identify any functional limitations or asymmetries (Warren, Smith, & Chimera, 2015). These movements are chosen to challenge an individual's balance, stability and mobility.

Researchers have found that stabilization and activation of the core is a foundation for all movement. This leads to the ability for all of the other joints to mobile and function optimally (Warren, Smith, & Chimera, 2015). Proximal stability is imperative for distal mobility (Cook et al., 2014). There is no standard way to measure core strength and stability, but when assessing this, it is important to use multiple plains. When assessing these multi-planar movements, the quality of the movement is indicative of core function (Warren, Smith, & Chimera, 2015). This premise is apparent in the FMS.

Each movement was picked because of its emphasis on certain aspects of human movement. The seven fundamental functional movements used in this assessment include: inline lunge, hurdle step, shoulder mobility, deep squat, active straight leg raise, trunk stability push-up, and rotatory stability. There are four different scores an individual can receive, and they range from a score of zero to three. A score of zero is given when an individual experiences pain during that particular movement. A score of one is given if the individual cannot complete the test, but there is no pain when performing the movement. A score of two is issued if the individual completes the movement with some form of compensation. A score of three is only administered if an individual performs the movement without any compensation and maintains proper alignment throughout the entire movement. There are three additional tests that are considered a clearing test and are made to uncover pain in ways the movements may not, such as the Spinal Extension Test and Shoulder Impingement Test (Warren, Smith, & Chimera, 2015).

Of these eight patterns, there are five movements that are performed bilaterally. This allows the individual to be tested for any asymmetries in those particular patterns, which is the highest priority for correction in this system (Warren, Smith, & Chimera, 2015). Poor training or faulty movement patterns in athletes can lead to neuromuscular imbalances in terms of leg dominance and trunk dominance. Although some compensation is needed for competing at a high level in different sports, there is a point in which this compensation becomes dysfunctional. This alters performance and can potentially manifest itself into a painful pattern (Warren, Smith, & Chimera, 2015).

There is a max score of 21 for this assessment but a recommended score of at least 14. Previous studies done on players in the National Football League found that individuals who scored less than a 14 on their FMS had a 11.7 times higher chance to get injured than athletes who scored higher than a 14 (Kiesel et all, 2007). Shojaedin et al. (2014) found that athletes with a score less than 17 on their FMS have approximately a 4.7 times greater chance of suffering a lower extremity injury during their regular competitive season. Although these results seem astonishing in their ability to predict an athletes musculoskeletal health throughout the competitive season, not all studies have drawn similar conclusions. Warren, Smith and Chimera (2015) found that their study that analyzed 195 student athletes showed different results. Even though they had hypothesized that the lower FMS scores would be associated with a higher percentage of non-contact injuries, their findings did not yield such results.

Although the Functional Movement Screen is not flawless, it can be an effective tool in identifying an athlete's likelihood of getting injured (Letafatkar, 2014). It also helps assess and identify faulty movement patterns and asymmetries that can be addressed to lower an athletes risk of injury and possibly aid in improving performance (Warren, Smith, & Chimera, 2015). Both of these are important when dealing with an athletic population in both a strength and conditioning and clinical setting.

Active Straight Leg Raise

The Active Straight Leg Raise Assessment (ASLR) is the most important assessment move in the Functional Movement Screen when addressing the lower body and core function. This movement provides information about the individual's ability to transfer load, flexibility and the motor control of the lumbo, pelvic, and hip complex (Sharman & Cresswell, 2006). The ASLR also tests an individual's ability to disassociate his or her leg from his or her trunk while keeping stability in the torso. This movement also assesses active flexibility in the hamstring and gastro-soleus and active extension in the opposite hip (Cook et al., 2014).

There are points of performance that must be obtained and maintained in the Functional Movement Screen's Active Straight Leg Raise Assessment. When performing the ASLR, the individual being assessed lays supine on the floor with arms in the anatomical position and maintains his head flat on the floor. Underneath his knees is a two by six. When the test is being performed, the individual slowly lifts the leg being tested with an extended knee and a dorsiflexed ankle. The back of the opposite knee remains in contact with the two by six, the leg remains in contact with the ground and the ankle dorsiflexed. It is also important that there is no rotation in either leg or the hips as this show a compensation pattern (Cook et al., 2014).

To obtain a three on the ASLR, the individual needs to show complete control and no compensation patterns as the ankle is lifted past mid- thigh. A score of two is given when the individual completes the ASLR without compensation and the ankle reaches between the middle of the opposite knee and the middle of the thigh. A score of one is given if the individual can not bring their ankle pass their opposite knee (Cook et al., 2014).

A score less than a three needs to be addressed, and the limiting factors of the individual that was tested need to be identified. From this point specific tests such as the Thomas Test or Standing Toe Touch Test can be utilized to assess illio-psoas or hamstring restrictions respectively (Cook et al., 2014). With a score of two, the individual either has one or a combination of minor hip mobility asymmetries, unilateral tightness, or a stability dysfunction on the non moving limb (Cook et al., 2014). If there is improper activation of the iliacus, rectus femoris, adductor longus or psoas of the moving leg, there will be limitations in the height reached. The contralateral psoas is also active in the down leg to help stabilize the pelvis. Dysfunctions in this could lead to a poor result in the assessment (Hu, 2011). A score of one generally means global tightness and flexibility issues (Cook et al., 2014).

In a clinical setting, this movement can be performed and utilized in a number of ways. For example, to assess pregnancy-related posterior pelvic pain, an active straight leg raise is performed. If there is pelvic pain, the therapist places pressure on both sides of the pelvis to compress it. Another rep is then performed. If the pain subsides, it informs the clinician that there is an issue with pelvis stabilization (Westwater, Adams, & Kerry, 2010).

The Active Straight Leg Raise Assessment assesses an athlete or individual's ability to transfer a load between the spine and legs via the pelvis. During this movement, the rectus abdominis, transversus abdominis, internal obliques, external obliques and bilateral psoas engage to keep the pelvis and spine stable. The hip flexors are in charge of bringing the leg up (Hu, 2011). The Iliacus, rectus femoris, adductor longus and psoas activate ipsilaterally to make this hip flexion happen. The psoas is involved in hip flexion, but its main focus is for both bilateral muscles to stabilize the lumbar spine (Hu, 2011).

Previous research done on Division II NCAA athletes shows that bent knee passive flexibility has a negligible correlation to the score on an Active Straight Leg Raise Assessment. While hip flexion is important for this movement, there can be many other kinetic chain factors at play such as hamstring and calf tightness. Lack of flexibility in those areas may only be part of the issue. As mentioned before, this test also assesses motor control as this is an active functional movement. Improper core muscle recruitment and inability of the core musculature to stabilize the pelvis may be a cause of a poor test score. With the absence of adequate hip flexion, other movements and areas of the hip and lower leg pick up the slack. With this study, they found that the active straight leg raise had a greater correlation between hip internal and external rotation. They hypothesized that because the individuals rotated from the hip during the active straight leg raise, internal and external rotation was a limiting and correlating factor. If this is the case, then the active straight leg raise was not assessed appropriately for this study. For a correct assessment of the active straight leg raise, there should be no deviation and rotation of the femur or foot. (Jenkins et all 2017)

The Active straight Leg Raise Assessment is a great tool that can assess core and lower body flexibility and motor control when used correctly. This assessment can be utilized for multiple purposes and in multiple settings (Westwater, Adams, & Kerry, 2010). This gross movement pattern can also help you break down and lead you to more direct areas of focus. These areas could have an immediate effect on improving hip and core dysfunction (Cook et al., 2014).

Types of Stretching

Flexibility is a muscle's ability to lengthen. This allows one or multiple joints to move through a range of motion(the efficacy). Stretching is a key element for rehabilitation settings and sports settings in order to restore optimum range of motion (Yıldırım, 2016). Appropriate flexibility is essential for biomechanical function and movement (the efficacy). There are many methods and ways that have been shown to improve flexibility. Static stretching is one of the most common interventions for improving range of motion, but there are also other methods that have been shown to be more effective (Yıldırım, 2016).

Proprioceptive Neuromuscular Facilitation

Proprioceptive neuromuscular facilitation utilizes methods of harnessing the response of the neuromuscular mechanism through stimulation of the proprioceptors. These reflexes are used by the body to relax a muscle increasing in muscle length, but it can also increase muscular tension. Proprioceptive neuromuscular facilitation uses some kind of isometric contraction and relaxation which utilizes the theory of neural excitability depression (Westwater, Adams, &

Kerry, 2010). The theory of neural excitability depression is similar to homeostasis. After a contraction or excitation, there is a relaxation of the muscle via the nervous system. During the relaxation portion the stretch can be increased to ranges of motion that would not have been available prior to this (Sharman & Cresswell, 2006). There are two main methods of proprioceptive neuromuscular facilitation that are used, contract relax and agonist contract relax (Westwater, Adams, & Kerry, 2010).

Contract Relax

In clinical and sport performance settings, the contract-relax methodology of proprioceptive neuromuscular facilitation is the most popular. This can be done alone but is considered much more effective when done with a therapist or clinician. To perform this type of stretch, the individual being stretched or performing the stretch on himself would perform an isometric contraction, engaging the muscle he is trying to stretch. After, he will be able to stretch that muscle a little bit farther.

When looking to improve the active straight leg raise, we will focus on increasing hip flexion, knee flexion and dorsiflexion (Westwater, Adams, & Kerry, 2010). To utilize contract relax to improve these joint ranges, the individual being stretched would lie down on a treatment table and have the non stretched leg strapped to the table. The clinician would take the individuals leg and press it straight up to find their passive range of motion limit for this movement. Once that limit is found, the individual being stretched is going to contract the hamstring and gastroc-soleus complex into the resistance that the clinician would be providing. After a predetermined amount of time, the individual would relax and the clinician would be able to stretch these muscles a little bit farther. This can be performed multiple amounts of times to help drastically improve an individual's range of motion.

Contract relax, also known as autogenic inhibition, is effective by utilizing neurological mechanisms that get the chosen muscle to relax. Autogenic inhibition occurs in a targeted muscle by decreasing the excitability because of inhibitory signals sent from its Golgi tendon organs (Hindle, 2012). The reduced motor drive following a contraction is a factor that is believed to assist the target muscle in elongation. This is why there is such substantial gains following a contract relax session of proprioception neuromuscular facilitation (Sharman & Cresswell, 2006).

Agonist Contract Relax

The less popular type of proprioceptive neuromuscular facilitation, agonist contract relax, has been found to be more effective than its more popular counterpart. Youdas et al. (2010) found that the agonist contract relax method of PNF was more efficient in increasing knee extension than the more popular contract relax method. This style also uses different neurological mechanisms, reciprocal inhibition, to achieve an improvement in a target muscle.

Agonist contract relax is performed by contracting the opposite muscle then stretching the target muscle. If the focus is to improve the active straight leg raise, the individual being stretched would lie down on a treatment table and have the non stretched leg strapped to the table just like the previously mentioned method. The clinician would take the individual’s leg and press it straight up to find his passive range of motion limit for this hip flexion. Once that limit is found, the individual being stretched is going to isometrically contract the hip flexors and anterior tibialis into the resistance that the clinician would be providing. After a predetermined amount of time, the individual would relax and the clinician would be able to stretch these muscles a little bit farther. This can be performed multiple amounts of times to help drastically improve an individual's range of motion (Westwater, Adams, & Kerry, 2010).

Agonist contract relax works by a mechanism called reciprocal inhibition. By contracting the opposite muscle activation levels in the target muscle decrease (Sharman & Cresswell, 2006). The relaxation of the target muscle is a result of decreased neural activity. This is the mechanism in which muscles tend to work, one contracts and the opposite relaxes. This prevents muscles from working against each other (Sharman & Cresswell, 2006).

Duration and Intensity of Contraction

There have been many durations and intensities that have been investigated. Youdas el al. (2010) found that 20 second cycles of a PNF stretch can lead to substantial improvements in range of motion. They also found that a ten second cycle was found to be effective. Most have found that a one to one ratio of isometric contraction to stretch is sufficient (Westwater, Adams, & Kerry, 2010). A maximal contraction has typically been used because it was previously believed that the Golgi tendon organs only respond to high forces, but this is not true. The Golgi tendon organs are sensitive to low force as well (Sharman & Cresswell, 2006).

Possible Negative effects

With both types of proprioceptive neuromuscular facilitation, contract relax and agonist contract relax, there can be some negative side effects. On of the most common would be muscle soreness. This can happen via two different ways. The first way would typically happen in a clinical setting where an individual is not physically fit and is asked to maximally contract. If this individual has not maximally contracted a muscle in quite some time, multiple reps of this would cause them some soreness. The second way would be if an individual were stretched too far. An over lengthening of the tissue may also cause some soreness and typically happens in a sports performance setting with a trainer who has not been trained properly on how to administer this type of stretching (Westwater, Adams, & Kerry, 2010).

Motor Control and Motor Learning

Motor control and motor learning are huge subsets of research that can be applied to many different fields. For this study, we look at how motor control and even motor learning can be applied to improving the active straight leg raise. As previously mentioned, the physical demands of core stability and pelvic controle are immense. With weak, poor core control it will have a negative effect on global muscle systems (Borghuis, J., Hof, A. L., & Lemmink, K. A. P. M 2008).

In the Functional Movement Screen, two issues may arise when a poor score on an assessment is obtained. It could be a flexibility issue or a motor control issue. To discern which one it is, the individual is taken through a passive range of motion through the same movement. If the degree of flexibility does not improve, then there is a flexibility issue. If the degree of flexibility does improve then one can assess there is a motor control issue (Cook, G., Burton, L., Hoogenboom, B. J., & Voight, M. 2014). In the last situation, the individual being tested has the appropriate degree of range of motion but does not have the adequate pelvic control or core stability to support that movement (Borghuis, Hof, & Lemmink 2008).

Conclusion

In conclusion, improving hip and leg flexibility along with core stability and motor control can help improve an athlete's performance and decrease one's risk of injury. If an athlete can keep from being injured and be healthier longer, they will increase the amount of practice time they have and in return improve in his sport. The athlete's health also has a financial impact on the team he plays for as well. The Functional Movement Screen and more specifically the Active Straight Leg Raise Assessment can help assess these previously mentioned areas of emphasis. There are many methods of improving the active straight leg raise that can be effective

(Cook, Burton, Hoogenboom, & Voight 2014). One of the most effective ways to improve flexibility is proprioceptive neuromuscular facilitation. There are two main types of proprioceptive neuromuscular facilitation that can be utilized. The contract relax is a tool that targets mainly flexibility limitations. The agonist contract relax addresses more of motor control system and less of the flexibility component (Blazevich et all 2012). Recent research suggests that when improving the Active Straight Leg Raise Assessment score, when necessary, it can decreases an athletes chances of receiving an in season injury by more than four times.

CHAPTER III

METHODOLOGY AND FINDINGS

Participants

For this study, the general population will be used. The subject's ages range from 18 to 50 years old. Subjects include both male and females along with people from multiple backgrounds. The significant level will be set at .05. The alpha error probability will be .05, and the power would be .8. The effect size would be set at .8 because previous studies that measured similar modalities used such. For this study, there are three groups and a total of six measurements will be taken per individual, three pre-intervention and three post-intervention. There will be a sample size of 30 subjects. Of these 30 subjects, 16 were female and 14 were male with a mean age of 31 years old.

Instrumentation

For this study, there are specific standards for measurement, and a specific tool will be used as will be described in the study. To assess and measure the active straight leg raise, the clinician would use goniometer on the active leg (Yıldırım, 2016). To increase the validity, a close eye is placed on both knees. Compensations will occur in this movement, in an effort to receive a better score. In order to limit the compensations, strict guidelines will be implemented. Subjects are informed of the strict guidelines for this assessment. The strict guidelines are as follows: The subjects would be laying on his or her back, supine, with a two by six placed under his or her knees. The motionless leg must maintain contact with this two by six for the entirety of the test. Also on the active leg, the subject must maintain the knee flexed and ankle in dorsiflexion throughout the duration of the movement. The toes, knees and hips must remain inline to insure there is no rotation of the tibia or femur (Hu et. al., 2012). The slightest deviations from the criteria would designate the end of range for the active straight leg raise. In an effort to maintain consistency and correctively measure the effectiveness of these modalities, these guidelines must be stringently followed.

A goniometer is used to measure the angle of the hip during the assessments. The middle of the goniometer will be placed inline with the subject's hip capsule. The lines of the tools will be placed in line with the middle of the lateral malleolus of the left leg and medial malleolus of the right leg. This anatomical landmark was chosen to maintain consistency throughout the testing period.

An informed consent was created, an application to conduct the study was submitted and approved by the University of Texas Rio Grande Valley Human Subects Committee. The individuals participating will be informed and sign the informed consent document. The consent allows the subject participating in the study to know what will be measured and tested. The data will be reported anonymously to protect the identification of the subject.

Procedures

Before conducting the study, the review board will give approval. All of the subjects will be contacted in person at Pop's Gym. The first 30 subjects who agree to testing will be chosen for the study and then given a number that corresponds to the order in which they reached out. They will then be placed in to the three groups: passive stretch, active stretch, and control randomly. The numbering is as follows 1= control, 2= passive stretch, 3= active stretch, 4= control, 5=passive stretch, 6= active stretch, ect. There will be no documents that identify a link between the subjects in the study and the data collected from them. The study will be conducted immediately after the subject agrees and signs informed consent.

On the day of the test, the active straight leg raise will be assessed and measured on the right leg. The goniometer will be placed at the right hip to measure the degree of hip flexion achieved. The subject will attempt the active straight leg raise three times, and all three attempts are then recorded. The directions and specifications for this measurement have been placed in the instrumentation section. Following the collection of the measurement, the clinician performs three sets of three repetitions of the specified modality, unless the subject was selected for the control group. One repetition consists of a 30 second stretch and a 30 second relaxation period. This is to be repeated three times. The specifics for each treatment group are explained below.

For passive stretch, the subject lays on a massage table with the leg not being stretched strapped to the table. The clinician's hand will be placed on the posterior portion of the subject's leg in the region of the ankle. The subject will keep his or her leg straight while stretching the leg in line with the hip. The leg will be gently pushed towards the subject's same side shoulder until muscular resistance is hit. The subject will be asked to contract the leg, by pushing into the testers hand for five seconds. The subject will be asked to contract and push with only 20% of their leg strength. The subject then relaxes and the tester stretches the leg forward until resistance is felt again. The leg is held there for the remaining 25 seconds. This is then followed by 30 seconds of rest and repeated two more times. This stretching portion takes around 3 minutes to complete.

For the active stretch, the subject lays on his or her back with both legs straight and up in the air. There is no partner needed for this active stretch. The subject will keep their hips on the ground the entire time. They will also keep both knees extended and ankles dorsiflexed for the entirety of the exercise. It is important to note that different levels of flexibility will yield different starting points with the subject's legs. The subject keeps the right leg in the air while slowly lowering the straight left leg to the ground. Each rep should take around 6 seconds to complete. The subject will perform 5 to 7 controlled repetition within the 30 second window. This is then followed by a 30 second rest period and repeated two more times. This stretching portion takes around 3 minutes to complete.

After the stretching modalities have been administered, the active straight leg raise would be assessed and measured again. The goniometer will be placed at the right hip to measure the degree of hip flexion achieved post intervention. The active straight leg raise will be attempted three times, and all three attempts will be recorded. This data is kept secure and not shared until the analysis is performed.

Data analysis

Data analysis will occur upon completion of the series of assessments. Descriptive statistics will be used to calculate means and standard deviation in the IBM program SPSS. The average of the three pre and post test will be taken and analyzed using an instrument for data analysis called Analysis of Variance (ANOVA). This will be used to determine the differences of pre and post results between the interventions. The measurements are taken on the degree of hip flexion in the active straight leg raise before and after the specified intervention, passive stretch, active stretch, and the control. The p value will be set at $<.05$, and if the value is under this, a post Hoc test will then be conducted to look at the level of significance between interventions.

Results

When assessing the degree of hip flexion in the Active Straight Leg Raise for the control group, the mean for measurements taken for the before was 70.6 degrees and after was 72.07 degrees. For the active stretch group, the mean for measurements taken for the before the stretch was administered was 70.7 degrees and after was 76.3 degrees. For the partner assisted passive stretch group, the mean for measurements taken for the before the stretch was administered was 70.8 degrees and after was 77.8 degrees. After running the results in to SPSS, it was found that there is a significant difference between the control groups and the groups in which the exercises were prescribed, the active and partner assisted passive stretch. This gives statistical proof that the improvements in the Active Straight Leg Raise in the active group and the passive group were not random. The improvement in the degree of hip flexion came from the utilization of the stretches. The p value was 0.05 and the null hypothesis was rejected. A large effect size of .08 was used for this study. A large effect size was used because of the hip flexion even repeating the movement the active straight leg raise the scores will improve. Having a large effect size will help differentiate the gain in range of motion.

After receiving these results from the ANOVA, a post Hoc test was ran to determine where the differences came from and if there were any specific differences between the groups. When looking at the control in comparison to the partner assisted passive stretch, the significance is 0.05 and the mean difference was 5.503. This means that there is a statistical significance in the effect of the partner-assisted stretch. When looking at the control in comparison to the active stretch group, the significance is 0.05 and the mean difference 4.102. This also shows that there is a statistical significance in this therapeutic modality. When both therapeutic modalities were analyzed in comparison to one another, the significant value that was obtained was 0.481 and the mean difference was 1.401. This shows that there is not a statistical significance between the two treated groups. The overall calculated effect size of this study was 1.4884 which was greater than the large effect size of .8 that was chosen. The effect size between the control group and the Partner assisted passive stretch group was 1.432. The effect size between the control group and the Active stretch group was 1.0674. The effect size between the to experimental groups, partner assisted passive stretch and the active stretch group, was 0.3646.

Descriptives **Table 4.1**

Outcome

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
1.00	10	1.4650	1.08104	.34186	.6917	2.2383	.33	3.33
2.00	10	6.9680	2.64666	.83695	5.0747	8.8613	3.33	11.00
3.00	10	5.5670	3.65643	1.15626	2.9513	8.1827	1.67	13.33
Total	30	4.6667	3.51087	.64099	3.3557	5.9776	.33	13.33
1								
2								
3								

The overall effect size f = **1.4884**

The effect size for Group 1 vs Group 2 is f = 1.4320

The effect size for Group 1 vs Group 3 is f = 1.0674

The effect size for Group 2 vs Group 3 is f = 0.3646

ANOVA **Table 4.2**

Outcome

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	163.574	2	81.787	11.389	.05
Within Groups	193.886	27	7.181		
Total	357.460	29			

Multiple Comparisons **Table 4.3**

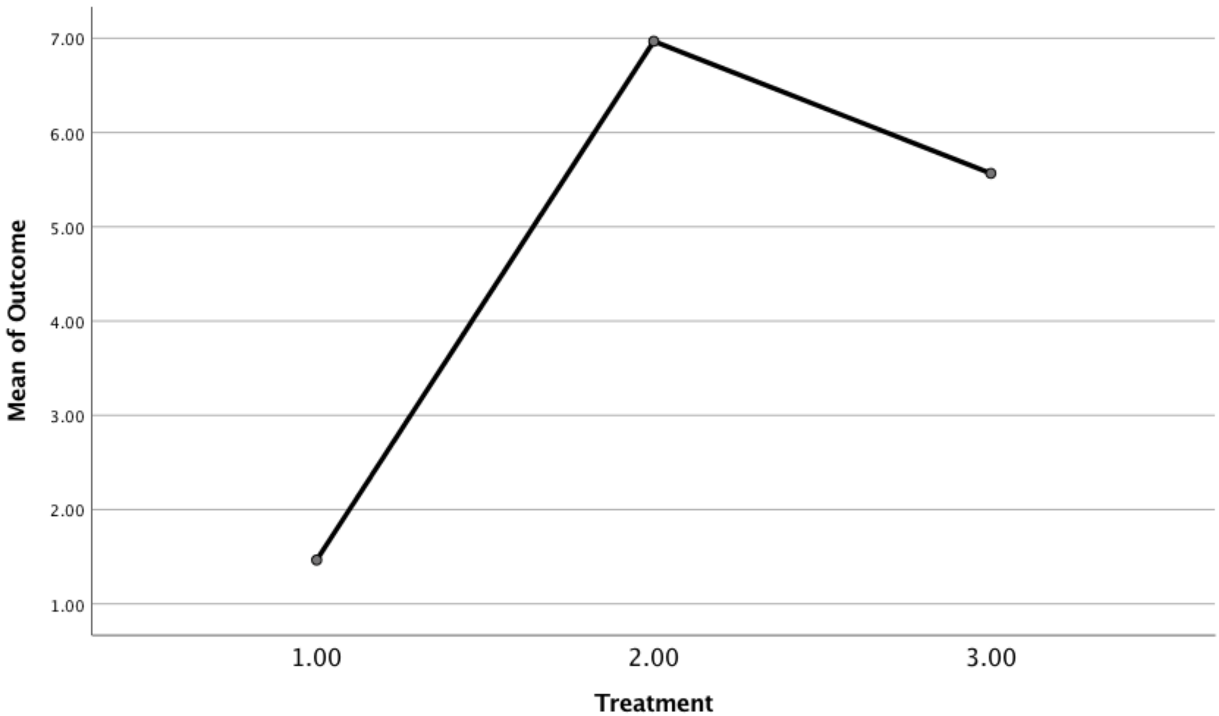
Dependent Variable: Outcome

Tukey HSD

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-5.50300*	1.19841	.05	-8.4744	-2.5316
	3.00	-4.10200*	1.19841	.05	-7.0734	-1.1306
2.00	1.00	5.50300*	1.19841	.05	2.5316	8.4744
	3.00	1.40100	1.19841	.481	-1.5704	4.3724
3.00	1.00	4.10200*	1.19841	.05	1.1306	7.0734
	2.00	-1.40100	1.19841	.481	-4.3724	1.5704

1- Control
2- Partner Assisted Passive Stretch
3- Active Stretch

Means Plots **Table 4.4**



1- Control
2- Partner Assisted Passive Stretch
3- Active Stretch

The results confirmed the hypothesis that within a short time of treatment there is statistical evidence that supports that the two treatments are effective in improving the active straight leg raise. The analysis also shows that there is no statistical difference in the results obtained from the active stretch group and the partner assisted passive stretch group in a study of this size. This result confirms the hypothesis that within this short amount of time similar results can be obtained by the active stretch in comparison to the partner assisted passive stretch.

CHAPTER IV

SUMMARY AND CONCLUSION

Lower body injuries can be detrimental to the development of athletes and have a substantial impact financially on their team (Warren, Smith, & Chimera, 2015). The Functional Movement Screen has been used to evaluate movement patterns and set a standard for said movement patterns. By assessing the athlete's flexibility and motor control patterns, using the Functional Movement Screen, these issues can be addressed and the likelihood of an individual attaining a lower body injury can be significantly reduced. The most foundational lower body assessment from this screen is the Active Straight Leg Raise Assessment (Cook et al., 2014). The Active Straight Leg Raise Assessment assesses hamstring flexibility, contralateral hip flexor flexibility, core activation and pelvic control. Without all of these aspects working in synchrony, the active straight leg raise will be performed sub optimally. Improving the active straight leg raise has been shown to have a positive impact on other lower body assessments in the Functional Movement Screen. The conclusion can be drawn that by improving the active straight leg raise, the likelihood of obtaining a lower body injury can be decreased (Westwater, Adams, & Kerry, 2010).

The hypothesis for this study was that by implementing an active stretch and a partner assisted passive stretch the active straight leg raise would improve. The statistical analysis showed just that. There was statistical evidence that the gain in range of motion from both active stretch and a partner assisted passive stretch were significant when analyzed against a control group. The two stretches were then analyzed in a Post Hoc Test to determine whether there was a statistical difference between the two. The data shows that there is not for this sample size. Further research with a larger sample size is necessary to determine if there truly is no significant difference between the two.

Although these findings were significant, more research is still needed to analyze the long term effects. Future potential research should look at the effects of these stretches when conducted on a consistent basis over an allotted amount of time, such as three times a week over twelve weeks. Another area for potential research would be the length in time that the stretch has an effect on the active straight leg raise. For this study the stretches were performed only for a total of 90 seconds, future research should investigate how long are the gains in hip flexion on the Active Straight Leg Raise maintained.

These findings can have a great impact on group settings such as strength and conditioning settings and for pre-game settings. With the active stretch being just as effective as the partner assisted passive stretch, the active stretch can be implemented before weight training, practice and games in a group setting to lower the likelihood of lower body injuries. This would also help athletic trainers and therapist be more efficient with their time. The findings suggest that the active stretch is as effective as the 1 on 1 passive stretch that is typically administered by them. This would leave more time for specific treatments for individuals. The findings from this study have a broad and general impact across all sport and can potentially keep athletes healthier throughout their career and save teams substantial amounts of income that is typically lost due to injuries.

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BIOGRAPHICAL SKETCH

Cortney Ray Payne is an Exercise Physiologist who also specializes in movement coaching and therapy. His current and permanent mailing address is 3827 Birkdale Dr., Fort Worth, Tx 76116. His permanent email address is cortpayne@gmail.com. He obtained an Associate's of Science degree from San Jose City College where he also was a starting pitcher on the baseball team. He then received a scholarship to play baseball at the University of Nevada Las Vegas. It was there where he graduated with a Bachelors of Science in Kinesiology. After graduating, he worked for three years as the lead Exercise Physiologist for the Children's Heart Center of Nevada. There he conducted cardiac rehabilitation for patients that had congenital heart disease and for those who were at risk for developing heart disease. Upon moving back to Texas to begin his Masters in Science, he opened a corporate wellness facility, Pop’s Gym, which specializes in personal and group training.

Cortney earned his Master’s Degree in Science from the University of Texas Rio Grande Valley. He is also a certified Clinical Exercise Physiologist through the American College of Sports Medicine. He is also Level 2 certified in the Functional Movement Screen. He is also Level 3 Medical Certified Fascial Stretch Therapist through the Stretch to Win Institute. Cortney has many other certifications and has attended may seminars, workshops, and lectures because he believes continuing education is key for development.