EFFECTS OF TWO DIFFERENT STARTING STANCES ON 10M SPRINT PERFORMANCE TIME IN JUNIOR COLLEGIATE FOOTBALL PLAYERS FOLLOWING A 6-WEEK SPRINT TRAINING PROGRAM

A Thesis

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by

Cindy Lee Rutledge

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Department of Kinesiology
Abstract

of

EFFECTS OF TWO DIFFERENT STARTING STANCES ON 10M SPRINT PERFORMANCE TIME IN JUNIOR COLLEGIATE FOOTBALL PLAYERS FOLLOWING A 6-WEEK SPRINT TRAINING PROGRAM

by

Cindy Lee Rutledge

This study compares the forward step to the plyo step sprint start technique. The purpose of this study was to incorporate a 6-week training program prior to testing the two techniques so the athletes have time to get comfortable with stances and train in them. Forty-six volunteer subjects from the American River College football program were recruited for this study. For the pretest, all participants lined up on the starting line and sprinted for 10m using the plyo-step technique. They were then randomly split into two groups (plyo and forward step groups) and preceded with a 6-week sprint-training program provided by the coach. The posttest was the same as the pretest for the plyo group and the forward step group, however the F-group tested in the forward step technique.

The results from this study revealed that both starting techniques had statistically significant faster times after the 6-week sprint-training program. When compared to each other, the forward step had significantly faster times than the plyo step technique. Further research is
needed to examine the effects of different starting stances on other sports. The next step in research might be to change the environment in which the athletes train and test in, for example, an indoor court.

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Committee Chair
Harry Theodorides, Ed. D

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Date
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Figures</td>
<td>ix</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>3</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>3</td>
</tr>
<tr>
<td>Assumptions</td>
<td>4</td>
</tr>
<tr>
<td>Limitations</td>
<td>4</td>
</tr>
<tr>
<td>Delimitations</td>
<td>4</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>5</td>
</tr>
<tr>
<td>Hypothesis</td>
<td>5</td>
</tr>
<tr>
<td>2. REVIEW OF LITERATURE</td>
<td>6</td>
</tr>
<tr>
<td>Speed</td>
<td>6</td>
</tr>
<tr>
<td>Sprint Training and Running Mechanics</td>
<td>9</td>
</tr>
<tr>
<td>Conditioning and Periodization</td>
<td>11</td>
</tr>
<tr>
<td>Strength Training</td>
<td>12</td>
</tr>
<tr>
<td>Plyometrics</td>
<td>14</td>
</tr>
<tr>
<td>Starting Stance Takeoff Technique</td>
<td>16</td>
</tr>
<tr>
<td>Summary</td>
<td>18</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
<td>20</td>
</tr>
<tr>
<td>Participants</td>
<td>20</td>
</tr>
<tr>
<td>Procedure</td>
<td>20</td>
</tr>
<tr>
<td>Training</td>
<td>21</td>
</tr>
</tbody>
</table>
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figures</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 10m Sprint Pre- and Post-Test Results</td>
<td>24</td>
</tr>
</tbody>
</table>
Chapter 1
INTRODUCTION

Football players must be able to go from a still, standing athletic stance to exploding as quickly as possible to sprint down the field or hit their opponents with a significant amount of force at the drop of a dime. Thus, it can be argued that speed is one of the key factors of success in American football players and more specifically, the initial take off (Brown & Vescovi, 2004; Cronin et al., 2007; Duthie et al., 2006; Frost & Cronin, 2011; Frost, Cronin & Levin, 2008; Gambetta, 1990; LaDune et al., 2012; Palmieri, 1993). Since these athletes have only a short distance to run before hitting or blocking an opponent, the initial take off of a sprint is important in developing as much speed and force as possible in the shortest period of time.

The starting stance of an athlete plays an important role in how fast they are able to take off. Consider a softball player in centerfield reacting to a shallow fly ball, a volleyball player at the back of the court sprinting to pick up a tip over the net, or a basketball player who has to transition from defense to offence in a matter of seconds. All of these players must transition from their athletic stance (feet parallel) to a forward movement as quickly as possible (Frost, Cronin, & Levin 2008). In football, receivers usually start with their feet staggered (one foot in front of the other), because they know they are running forward as fast as they can to hit their marks. Linebackers, however, start with their feet in a parallel, athletic stance similar to the ones previously mentioned, in case they need to change direction quickly.
When starting from a parallel, athletic stance and trying to explode forward, 95% of athletes will naturally take a slight step backwards before proceeding forward, which is called the false step or plyo-step technique (P) (Kraan et al., 2001). Some coaches believe this to have a negative effect on the athletes’ take off performance because it is an initial step in the wrong direction, which ultimately slows them down. These coaches are training their athletes to take their first initial step forward. This is called the drop-and-go or the forward step technique (F). The argument for the plyo-step is that it utilizes the stretch shortening cycle and it is a natural movement for athletes (LaDune et al., 2012).

The bottom line is how fast an athlete can run a short distance from point A to point B. In such a short distance and time frame, every little bit contributing to the movement counts. Researchers have analyzed strength training in relationship to sprint performance, running mechanics, speed training, and several other variables involved with short distance sprinting (Behrens & Simonson, 2011; Blazevich, 2001; Chelly et al., 2010; Cissik, 2004; Cissik, 2005; Cronin et al., 2007; Cross, 1991; Deane et al., 2005; Durck, 1986; Fletcher & Jones, 2004; Harris et al., 2008; Harrison & Bourke, 2009; Harris et al., 2008; Holm et al., 2008; Klinzing, 1984; Korchemny, 1985; McFarlane, 1987; Merlau, 2005; Myer et al., 2007; Newman, Tarpenning & Marino, 2004; Rimmer & Sleivert, 2000; Ross et al., 2009; Ruisz, 1987; Verkhoshansky & Lazarev, 1989; Young, 1993). There has been little research, however, on the initial starting technique of the athlete in sprint performance (Brown & Vescovi, 2004; Cronin et al., 2007; Frost & Cronin, 2011; Johnson et al., 2010; Kraan et al., 2001; LaDune et al., 2012).
Purpose of the Study

The purpose of this study was to compare the speed of the plyo-step sprint start technique (P) to the forward step sprint start technique (F) in junior collegiate football players after implementing a 6-week sprint training program.

Significance of the Study

This study was derived from several previous studies in which similar methods were used (Frost, Cronin & Levin, 2008; Frost & Cronin, 2011; LaDune et al., 2012). Results from these studies were controversial. According to Frost, Cronin and Levin (2008) and Frost and Cronin (2011), the plyo-step was the superior takeoff technique, because it demonstrated faster sprint times over the forward step. LaDune et al. (2012) results supported the forward step as the superior start technique because it showed greater values in center of mass velocity and center of mass displacement. None of the previous studies, however, lasted longer than 2 days. It seems as though, if 95% of athletes naturally perform the plyo-step technique out of reflex (Kraan et al., 2001), then it would be superior to the forward step. This study adds significance to the topic because it gave the athletes time to train in the forward step technique so it became a natural movement as well, to test against the traditional plyo-step.
Assumptions

1. All participants exerted maximal effort while participating in the pre- and post-tests.
2. All participants exerted maximal effort while participating in the training sessions.
3. All athletes were physically fit for a speed-training program.
4. All participants refrained from any additional training outside of the study.

Limitations

1. Outdoor weather conditions were not always ideal.
2. Several injury and illnesses occurred among the athletes during the training season.

Delimitations

1. The subjects in this study consisted of junior collegiate football players.
2. All subjects had at least 2 years of prior football experience.
3. The speed-training program in this study was limited to 2-hour sessions, twice weekly for 6 weeks.
Definition of Terms

*Athletic Stance* – Refers to a ready position stance with the knees slightly bent and feet parallel.

*Plyo Step (P)* – Refers to a sprint start stance in which the athlete begins with the feet in a parallel athletic stance and takes the first step backward before proceeding forward.

*Forward Step (F)* – Refers to a sprint start stance in which the athlete begins with the feet in a parallel athletic stance and takes a first initial step forward when beginning a sprint.

*Split Stance* – Refers to a sprint start stance in which the athlete begins with the feet staggered (one foot in front of the other) and the back foot comes forward at the start of a sprint.

*Maximum Running Speed* – The top speed an athlete is able to produce at a distance of at least 20m (Santana, 2000)

*Sport Speed* – The top speed an athlete is able to reach within most sports of 15-20m max (Santana, 2000)

*NSCA* – National Strength and Conditioning Association

**Hypothesis**

1. There would be no statistically significant difference in sprint speed from pre to post test among the P (plyo-step) group

2. There would be no statistically significant difference in sprint speed from pre to post test among the F (forward step) group

3. There would be no statistically significant difference between the F group and the P group.
Chapter 2

REVIEW OF LITERATURE

This review of literature begins with a discussion of speed and its application to sport. The following sections discuss how sprint training and running mechanics, conditioning and periodization, strength training, and plyometric training have an impact on speed performance. The final section focuses on how recent research has added starting stance takeoff technique to this topic.

Speed

Speed is a quintessential part of all sports in some way, shape or form (Klinzing, 1984). In most sports, an athlete must be able to accelerate as quickly as possible in a short distance (Baughman, Takaha & Tellez, 1984; Bennet, 2008; Brechue, Mayhew & Piper, 2010; Brown & Vescovi, 2012; Duthie et al., 2006; Frost & Cronin, 2011; Gambetta, 1990; Gough, 2006; Johnston et al., 2010; Kirksey & Stone, 1998; Klinzing, 1984; Kraan et al., 2001; LaDune et al., 2012; McBride et al., 2009; McCurdy, 2010; McFarlane, 1987; McFarlane, 1993; Palmieri, 1993; Santana, 2000; Verkhoshansky & Lazarev, 1989; Young, Benton & Pryor, 2001). With the exception of some track and field events, most sports sprint for distances less than 15-20m since average plays and rallies last only about 5-10 seconds (Santana, 2000). In such short distances and little time, every little technique, skill, and movement counts.

The 40-yard dash has been used as the main tool in the football scene for assessing an athlete’s speed. It is a measuring tool used by college recruiting staff to evaluate the athleticism of a potential scholarship prospect. Improving speed in the 40-
yard dash can be accomplished by implementing acceleration drills, top end speed training and resistive and assistive sprints (Gough, 2006). It is important to determine where the athlete needs the most work in the 40-yard dash by analyzing the 5-, 10-, and 20-yard times as well. Gough (2006) broke the 40-yard dash into 3 trainable parts: the start, acceleration, and top end speed. The start of the sprint can be manipulated through implementing explosive movements such as Olympic lifts and the use of plyometrics. Acceleration can be improved by training running mechanics and maintaining speed towards the end of the run implies some endurance training.

Despite the fact that the 40-yard dash is used as the primary speed-testing tool for football players, the following studies suggest that an alternative method might be more beneficial. The 40-yard sprint does not have strong scientific evidence to support its existence (Brechue, Mayhew & Piper, 2010). Gambetta (1990) states that absolute speed is not an important aspect of the game due to its nature. Players seldom run in a straight line for more than 3-5 steps without having to change direction, slow down, or stop to hit someone. Brechue, Mayhew and Piper (2010) suggest that acceleration in the first 5-10 yards is more important than linear speed. Improving football skill requires explosive reactions which suggest that players should be working on getting a better start to improve their speed performance in the game (Brechue, Mayhew & Piper, 2010). Because of the nature of American football and the type of movements involved, a 10- or 20-yard sprint and a change of direction test would be more applicable (Gambetta, 1990).

Since the 10- and 20-yard dash is so important in football and many other sports, finding ways to improve speed in this short distance is relevant (Brechue, Mayhew &
Piper, 2010; Brown & Vescovi, 2012; Brown & Vescovi, 2004; Cronin et al., 2007; Duthie et al., 2006; Frost & Cronin, 2011; Frost, Cronin & Levin, 2008; Klinzing, 1984; LaDune et al., 2012; Palmieri, 1993; Young, Benton & Pryor, 2001; Deane et al., 2005; Myer et al., 2007). Deane et al. (2005) found one way of improving the 10-yard dash by implementing a hip flexor-training program on recreational athletes for 8-weeks. Results showed that the training group had a statistically significant decreased speed from pretest at 2.076 seconds to posttest at 1.838 seconds. The control group increased speed from 1.931 (pretest) to 2.003 (posttest). Therefore, hip flexor strength has a relationship to sprint performance improvements (Deane et al., 2005).

Ground-based and incline treadmill training can also improve sprint start times (Myer et al., 2007). Myer et al. (2007) tested to see which of the two training methods (ground-based vs. incline treadmill) would be more beneficial to 9.1-meter sprint times and found that both showed the same average improvements from 1.75 ± .12 seconds to 1.68 ± .08 seconds in high school, female soccer players.

Fletcher and Jones (2004) found that active dynamic stretching before running improved 20-m sprint times in male rugby players. The researchers compared 4 different types of stretching (passive static, active dynamic, active static, and static dynamic). Both the passive static and active static groups increased 20-m sprint times while the active dynamic group significantly decreased sprint times from 3.24 ± .2 seconds to 3.18 ± .18. The static dynamic group had a decrease in time but it was not statistically significant.
Sprint Training and Running Mechanics

Much research has gone into improving athletic speed through sprint training and different running mechanics (Behrens & Simonson, 2011; Blazevich, 2000; Brechue, Mayhew & Piper, 2010; Cissik, 2004; Cissik, 2005; Cross, 1991; Klinzing, 1984; Mcfarlane, 1987; Mcfarlane, 1993; Ruisz, 1987). Speed improvement is a very broad and technical subject. There are many different beliefs and theories to improve these mechanics. Some experts believe that stride length is the most important key factor in developing speed and still others believe stride frequency is the more dominant aspect (Cross, 1991). Both are quite essential in this process since stride frequency multiplied by stride length can achieve maximum velocity (Behrens & Simonson, 2011).

Stride frequency and stride length each have various training methods to improve overall speed. Stride frequency has been addressed by applying over-speed training or assisted sprints with workouts such as: high-speed treadmill sprinting, elastic-cord towing, and downhill sprinting (Behrens & Simonson, 2011). Resisted sled training, weighted vest, and uphill sprinting are all examples of resisted training designed to improve stride length (Behrens & Simonson, 2011). Knowing which exercises to use for specificity training is the key.

Many coaches and experts use a variety of the exercises mentioned previously regarding resisted and assisted sprinting to improve overall sprint performance. In order to get more sport specific, coaches must examine their sport to determine which is the best method to implement. Behrens and Simonson (2011) found that because most sports
are played on level playing fields, the resisted sled training and assisted towing would be best to focus on sport specific tasks.

Running mechanics play another important role in speed development (Behrens & Simonson, 2011; Blazevich, 2000; Brechue, Mayhew & Piper, 2010; Cissik, 2004; Cissik, 2005; Craig, 2004, Cross, 1991; Fletcher & Jones, 2004; Klinzing, 1984; McFarlane, 1987; McFarlane, 1993). This is often the first task in a periodized model for speed training. In order to perfect the skills and techniques of running, it must first be practiced at slow speeds and then transferred to maximal speeds. Sprinting involves moving the body’s limbs at high velocities and the correct firing of motor units to make it possible (McFarlane, 1987).

There are a variety of different running mechanic drills that can be applied to increasing speed (Behrens & Simonson, 2011; Blazevich, 2000; Cross, 1991; McFarlane, 1987; Sherry et al., 2011). Many of these drills are used as warm-ups for conditioning and sprinting. Some examples of running mechanic drills are as follows: Ankle-ups to shorten the pendulum and increase stride frequency, sling-shots to develop the ankle-up technique, heel-ups to relax the quads, knees and ankles and improve stride frequency, seated running to shorten pendulum and increase shoulder flexibility, and form runs to relate drill work to sprint strides (Cross, 1991).
Conditioning and Periodization

Conditioning is a big part of improving sprint performance and maintaining speed over a period of repetitions (Baughman et al., 1984). It would be easy for an athlete to get fatigued during the middle of a game if they weren’t specifically conditioned during practices. This fatigue could ultimately lead to a reduction in speed performance. Conditioning is also a very broad topic and can be specified for each and every sport all the way down to individual positions.

When designing a conditioning program for any athlete, it is important to pay attention to the needs and demands of a sport as well as the program design variables laid out by the NSCA as follows: exercise interval (duration), exercise order, exercise: relief (exercise and relief intervals in a set), frequency (number of training sessions), intensity (amount of effort put in), recovery (rest time between reps), repetition (number of times the action is performed in a set), series (a group of sets and recovery intervals), set (a group of repetitions), and volume (amount of work performed in a training session) (Baechle & Earle, 2008).

There are different macro and mesocycles to consider when designing a sprint-training program to develop speed. Baughman et al. (1984) listed 3 phases to consider: the conditioning phase, pre and early season, and competitive. Ruisz (1987) broke it down even further within the macrocycle and created a basic preparatory period, followed by a speed endurance period, then a speed-training period, and finally the competition period. It is important to know how long a training period should last in order to see significant improvements in an athlete’s running capabilities. The basic
preparatory period should last about 6-7 weeks (Ruisz, 1987). There are several other sprint-training studies that lasted a duration of 6-7 weeks to support this notion (Harrison & Bourke, 2009; Kristensen et al., 2006; Meckel, 2012; Myer et al., 2007 Ross et al., 2009;).

During the conditioning period, athletes should be training 2 days per week with 24-48 hours of rest in between each session (Baughman et al., 1984). When training an athlete’s ability to accelerate, short sprints from 5-50 meters is desired (Cissik, 2005). Speed should be practiced in 20-80 meter distances of 90% or greater intensity with 3-5 minutes of rest between reps for maximal results (Cissik, 2005).

Strength Training

The relationship between strength training and improved sprint performance has proven to be a beneficial topic in research (Cronin et al., 2007; Durck, 1986; Harris et al., 2008; Hansen & Cronin, 2009; Johnston et al., 1995; McBride et al., 2009; Wisloff et al., 2004; Young, Benton & Pryor, 2001; Young, 1993). Strength is considered critical to speed development (Cronin et al., 2007). Wisloff et al. (2004) found improvements in the 10-meter sprint time through 1-repetition maximum (1RM) training in the free weight squat. Dowson et al. (1998) reported a correlation between knee extension torque and significantly faster sprint times for 15- and 35-meter distances. While working with weight machines, Harris et al. (2008), found no significant correlations between the 1RM squat and the 10- and 40-meter sprint times. It seems that free-weight, multiple joint exercises are more beneficial for increasing sprint capabilities.
McBride et al. (2009) conducted a study to see if there was a relationship between the 1RM squat and 5-, 10-, and 40-yard sprint times. The researchers used 17 division 1 football players. The participants were asked to perform a 1RM squat to a 70-degree knee angle. The athletes then performed a 40-yard dash while the researchers also measured their 5- and 10-yard split times. The researchers found a significant correlation between maximal squat strength and all 3 running distances. Thus, lower-body musculature plays a significant role in sprinting velocity.

Cronin et al. (2007) investigated longitudinal studies to determine the magnitude of strength development necessary for improved running speed. The researchers took a look at 18 previous studies. They found that in order to accomplish significant sprint time improvements an athlete should aim to increase his 1RM squat by 23% in a training period of 7-13 weeks with 2-3 days per week of strength training (Cronin et al., 2007). The findings in this research were specified towards male athletes 19-24 years of age. Load and rest periods were not clearly demonstrated in this research since there were many different applications.

Young (1993) looked into training for speed with heavy verses light loads and found positive effects for each. Light load training was found to be beneficial in developing various speed qualities, developed inter-muscular coordination, and was best if applied during the pre-competition phase in order to transition from general strength to sport specific strength. The heavy load resistance training produced explosive contractions and increased fast twitch fiber sizes (Young, 1993). Many coaches incorporate a variety of strength training loads for maximal results.
Deciding on which types of strength training exercises to use for improving speed depends on the muscles most used and the running mechanics. Short sprints from a stationary start appear to utilize more of the quadriceps muscle, while max speed sprints depend more on the hamstrings (Young et al., 2001). Other muscles involved include the gluteals, calves, hip flexors, some upper body, and postural stabilizing muscles. After analyzing this information, Young et al. (2001) came up with some strength exercises that best fit with the movements of running mechanics including, but not limited to: squats, power cleans, snatches, push presses, bench press, deadlifts, machine hip extension/flexion and lunges.

**Plyometrics**

Plyometric training plays an important role in developing power for speed development (Chelly et al., 2010; Delecluse et al., 1995; Harris et al., 2008; Holm et al., 2008; Kale et al., 2009; Renfro, 1999; Rimmer & Sleivert, 2000; McCurdy et al., 2010; Young, 1992). Delecluse et al. (1995) found that concurrent plyometric and sprint training had the greatest effect on improving speed in the first 10m of a sprint. Another study had the same findings and added that plyometric training can improve sprint performance for up to 40m with more modest improvements after the first 10m (Rimmer & Sleivert, 2000). This is important for most athletes who must develop a maximal amount of speed in short distances due to the nature of their respective sports.

Harris et al. (2008) conducted a study on well trained rugby players to compare squat jump training at maximal power loads of 55% of 1RM verses heavy loads at 80% 1RM on sprint performances. Results showed that the heavy load group decreased their
10m sprint times from $1.83 \pm .05$ seconds in the pretest to $1.78 \pm .05$ seconds in the posttest. The max power group also decreased their sprint times from $1.86 \pm .07$ seconds to $1.83 \pm .06$ seconds. Both groups showed a statistically significant difference in speed, though it seems that jump squat training in heavy loads may have a slightly more beneficial effect on 10m sprint times (Harris, 2008).

In another study, Chelly et al. (2010) incorporated a short-term plyometric training program on male soccer players during their season and found that it had a significant correlation with the athletes’ sprint speed. The researchers took 23 junior soccer players and split them into 2 groups (control group and experimental group). The experimental group had an 8-week plyometric training program (hurdle and depth jumping) added to their in-season program. The researchers found that the experimental group increased their velocity in the 40-meter sprint from $8.2 \ (m \cdot s^{-1})$ to $9.0 \ (m \cdot s^{-1})$, while the control group only increased from $7.8 \ (m \cdot s^{-1})$ to $8.0 \ (m \cdot s^{-1})$. Researchers also found statistically significant increases in the first 5-meters for the experimental group as well. This study indicated that 8-weeks of plyometric training (hurdle and depth jumps) enhances sprint velocities over both acceleration (0-5m) and maximal speed (0-40m) (Chelly et al., 2010).
Starting Stance Takeoff Technique

Few short-term studies have been performed to test the differences between short distance sprint starting techniques (Frost, Cronin & Levin 2008; Frost & Cronin 2011; LaDune et al., 2012). The results of the studies found are not consistent. None of the studies have been performed over a long period of time to incorporate a significant amount of training in either the forward step or the plyo-step take off techniques.

Frost, Cronin and Levin (2008) did a study comparing the forward step with the plyo-step technique in at least 3 trials of a 5-m maximal sprint and recorded the last 2 efforts. The researchers used 27 male athletes who had previous experience in running-related sports. None of the athletes had competed at the National level. The subjects started by doing the plyo-step technique since Kraan et al. (2001) stated that this method was a more natural reaction for up to 95% of individuals. After that, the subjects performed the forward step technique and the split stance in randomized orders. The split stance was used as a control group. The trials began with the sound of a buzzer and athletes ran through lighted timing gates set at 0-m, 2.5-m, and 5-m.

The results of the study showed that the greatest time difference was from the sound of the buzzer to the first starting gate. Between the 2.5-m and the 5-m gate, the plyo-step proved to be the overall faster sprint in the study. The researchers mentioned that debates against the plyo-step technique were assumed because it was an initial step in the wrong direction, which slowed down the overall take off. This notion appeared to be false in the study because the times between the two starts from the buzzer to the first
gate were nearly identical. In the overall 5-m sprint, the plyo-step produced more force and ended up being faster than the forward step technique.

During the study performed by Frost, Cronin, and Levin (2008), the researchers required the subjects to start with the right foot at all times, instead of letting them use the natural dominant foot. Since the researchers had all the participants begin with the plyo-step technique and then only randomized the final two techniques, fatigue might have been a factor contributing to the poorer performance of the false step. The researchers also completed all the data collection in one day, not allowing the participants enough time to get familiarized with the forward step technique.

A separate study performed by LaDune et al (2012) resulted in a different notion from what Frost, Cronin and Levin discovered. The previous study tested the two different starting positions over a timed distance. The researchers in this study came up with different results than Kraan, Frost, Cronin, and Levin. The study performed by LaDune et al. (2012) observed the initial steps of a sprint among athletes. The researchers used 10 NCAA Division 1 female soccer players. The athletes did one training session to get familiarized with each sprint technique. Five players started with the plyo-step then alternated between each technique while the other half started with the forward step then alternated between each technique. The athletes were given 3 trials of each starting stance with at least 3 minutes of rest in between. The best performance by each subject was used for analysis.

LaDune et al. (2012) found that the forward step was faster than the plyo step. The plyo step had greater accelerations than the forward step. In this study, overall, the
forward step proved to be the more superior start technique, which doesn’t go along with what Frost, Cronin, and Levin (2008) discovered. The reasons behind these differences in results are unclear. Each of the studies used a different technique in measuring different components of the two take-off methods. All of the studies showed that the plyo-step had greater acceleration values compared to the forward step (Frost & Cronin, 2011; Frost, Cronin & Levin, 2008; LaDune et al., 2012). Which of the variables are most important in sport is unclear since the studies performed were contradicting. Conducting a 6-week training program may produce different results than the ones found in these articles.

Summary

Speed development is an important factor in almost every sport. There are many different components of training that contribute to sprint speed. Research has been conducted on sprint training, running mechanics, strength training, and plyometrics and how they all impact speed performance.

In the sport of football, the question would be whether gaining more ground in a shorter period of time or producing more force in that same period of time is more important. Recently, researchers have studied the start of a sprint and how it affects the overall outcome of speed. Since, most sports only have a short distance to cover at maximum velocities, it makes sense that every little movement can contribute to the speed of an athlete. The three studies that were previously mentioned used a very short testing period (Frost & Cronin, 2011; Frost, Cronin & Levin, 2008; LaDune et al., 2012). The actual testing was performed in a day or two, leaving the athletes no time to train in any of the techniques. All three studies mentioned that the plyo-step technique was a
more natural reaction movement, yet none of them put their athletes through any training to optimize performance in either technique. If the plyo-step is a natural reaction then it would make sense to train an athlete in the forward step so they could optimize their performance in this method before testing to see which has a more superior affect.

All the studies performed on plyo-step verses forward step techniques have had one thing in common; none of them lasted more than 2 days. This study incorporated a 6-week training program to allow the athletes to get familiarized with the start step techniques before testing to determine which one was more beneficial.
Chapter 3

METHODOLOGY

The purpose of this study was to examine and compare the plyo-step (P) against the forward step (F) sprint start techniques on junior collegiate football players after implementing a 6-week sprint-training program.

Participants

After obtaining informed consent, 46 participants from the American River College (ARC) football program volunteered to participate in the study. All participants included in the study were required to have at least 2 years of prior football experience and no serious lower extremity injuries or surgery within 6 months prior to the start of the study.

Procedure

Prior to the study, all participants completed a pre-test to determine their natural sprint start techniques. Those that naturally performed the plyo-step technique were randomly split into two groups, a control group, which was the plyo-step (P) group and the testing group, which was the forward step (F) group. All participants began with a 20-minute warm up each day of training and testing. The pre- and post-tests were performed on weeks 1 and 8. Following the pretest was a 6-week sprint-training program provided by the ARC football coach at twice a week for a total of 12 sessions.
Training

All warm-up and training programs were provided by the ARC football coach and was not to be altered other than the starting techniques provided for each group included in the study. See Appendix A for a copy of the warm-up and Appendix B for the training program provided by the coach followed by Appendix C for a chart illustrating the session volumes.

Testing

Following a 20-minute warm-up on the first day of testing, all participants performed 10m sprints using the plyo-step technique. Each subject began with both feet parallel, toes touching the starting line and with knees slightly bent (when arms are extended down, they should be touching the knees) in the athletic ready position. Participants were asked to perform 3 maximal effort tests with at least 90 seconds rest between each sprint (Frost, Cronin & Levin, 2008; Frost & Cronin, 2011; LaDune et al, 2012). Times were recorded using 3 testers with stop watches and recording the average of the 3 times to control for human error. Each individual took his initial step with his dominant foot and sprinted as fast as he could through the finish line.

The posttest was performed similar to the pretest. The P group performed the same protocol as the pretest. The F group used the same procedures, however, they utilized the forward step technique for the posttest. Participants in the F group also started in the athletic stance with feet parallel to the line; however, the first step was forward with the dominant foot, eliminating the slight step backward.
Analysis

The data from this study were analyzed statistically by using dependent $t$ tests to compare pre-test to post-test and an independent $t$-test to compare between groups at the post-test. The first test analyzed the pretest and posttest results of each group to see if either one improved from start to finish. The second $t$ test compared the results found for the posttest of both groups in order to examine significance of the results. The alpha level was set to $P < 0.05$. 
Chapter 4

RESULTS

The purpose of this study was to compare the speed of the plyo-step sprint start technique (P) to the forward step sprint start technique (F) in junior collegiate football players after implementing a 6-week sprint training program to observe which one was faster. The initial pretest was conducted in January, at the start of their spring conditioning program. There were a total of 86 subjects involved in the pre-test. The training program lasted six weeks and it required all uninjured football players with at least 2 years of prior experience to participate. The posttest was done in March, during the last week of their spring conditioning. Because some of the subjects became injured or left the team during this training season, only 46 subjects completed the posttest. The subjects in this study were male, community college football players. Only those who completed at least 90 percent of the training program were included in the statistical analysis. Of the 46 subjects, 23 performed the plyo step technique and 23 performed the forward step technique.

Plyo Step, Forward Step, and Posttest Results

In the Plyo step group, athletes averaged a speed of 2.418 seconds in the pre-test and 1.882 seconds in the posttest. The t test analysis revealed a significant difference (P < 0.05) in speed from the pre- to the posttest (t = 17.777, df = 22).

In the Forward step group, athletes averaged a speed of 2.613 seconds in the pre-test and 1.749 seconds in the posttest. The t test analysis revealed a significant difference (P < 0.05) in speed from the pre- to the posttests (t = 28.407, df = 22).
In the Plyo step group, athletes averaged a speed of 1.882 seconds in the posttest. In the Forward step group, athletes averaged a speed of 1.749 seconds in the posttest. The *t* test analysis revealed a significant difference (*P* < 0.05) in speed between the two groups (*t* = 3.495, df = 22). The Forward step group was significantly faster than the Plyo step group.

![10m Sprint Pre- and Post-Test Results](image)

**Figure 1.1**

* Both groups were significantly faster from pre- to post-test.

** Forward step group was significantly faster in the post-test.
Hypotheses

1. There would be no statistically significant difference in sprint speed from pre-to posttest among the P (plyo-step) group was not supported by the data, meaning the speed of the posttest was significantly faster than the pretest after the six week training program.

2. There would be no statistically significant difference in sprint speed from pre-to posttest among the F (forward step) group was not supported by the data, meaning the speed of the posttest was significantly faster than the pretest after the six week training program.

3. There would be no statistically significant difference between the F group and the P group was not supported by the data, meaning the F group was significantly faster than the P group in the posttest.

Summary

There were significant improvements in the speed from pretest to posttest in both the P group and the F group. The F group was significantly faster than the P group in the posttest. These results reject the null hypotheses.
The purpose of this study was to compare the speed of the plyo-step sprint start technique (P) to the forward step sprint start technique (F) in junior collegiate football players after implementing a 6-week sprint training program to observe which one was faster. The football team in this study participated in a strength program 4 days per week (Monday-Thursday) followed by conditioning, speed and agility training. This study was implemented during their off season in the spring. All players were on the same program of an hour and a half of strength training followed by an hour and a half of conditioning out on the field. Nothing was altered in the coach’s strength or conditioning program other than the sprint start techniques that were utilized every time they practiced any kind of sprints. Any time the players began any kind of run or sprint, they were instructed to practice the sprint start technique that was assigned to them at the beginning of the study. The coaches and the researcher were always there at practices to monitor the players and make sure they were practicing the correct techniques.

Previous studies that examined the two different sprint start techniques (plyo and forward step) have produced varied results (Frost, Cronin & Levin, 2008; Frost & Cronin, 2011; LaDune et al., 2012; Kraan et al., 2001). The variety of results found by these studies could be related to the short-term nature of the studies. None of them lasted longer than a period of two days. Kraan et al. (2001), found that the plyo step technique
was a natural reaction for 95 percent of athletes without any previous training. The researcher in this study observed the athlete’s natural reactions when they were doing their trial runs and found that this study supported Kraan’s findings. Since this was the case, athletes should be given the chance to train in the alternative method of sprint start performance (forward step technique) in order to compare with the natural reaction technique (plyo step).

**Plyo Step**

In the plyo step sprint start technique, athletes showed improvement in times from pre- to posttest after implementing the 6-week training program. The improvement times were statistically significant. These results show that implementing a 6-week periodized training program at 4 days per week will improve an athlete’s sprint start time. The average 10-yard sprint time for the plyo step group during the pre-test was 2.42 seconds. The average sprint time for the posttest, after implementing the 6-week training program was 1.88 seconds. All of the athletes also participated in a combined strength-training program 4 days a week that could have maximized their results. Research has shown the explosive movements of Olympic weight lifting contribute the most to the first 5- to 10-yards of a sprint (Harris et al., 2008; McBride et al., 2009; Wisloff et al., 2004; Young, 1993).

**Forward Step**

In the forward step, athletes showed improvement in times from pre- to posttest after implementing a 6-week training program. The improved times for this group were also statistically significant. This group did the exact same combined speed and strength
training program as the plyo step group. The only difference between the two groups was the sprint start technique that they practiced throughout the course of the training. The average times for the forward step group at the beginning of this study was 2.62 seconds. After implementing the 6-week training program, the forward step group averaged a time of 1.75 seconds.

Plyo and Forward Step Posttests

Both the plyo step and forward step groups showed significant improvements in their 10-yard sprint times, suggesting that the 6-week combined strength and conditioning program contributed to reducing their times. In the posttest results of this study, the forward step group had statistically significant faster times than the plyo step group. This study suggests that when implementing a 6-week sprint-training program, the forward step sprint start technique is more beneficial than the plyo step sprint start technique. These results may be due to the fact that it gives the athletes more time to get familiarized with the running method, and therefore is more comparable to the alternative natural reaction method (plyo step). In comparison, a study by LaDune et al. (2012), conducted without a training program, produced results that showed the forward step had significantly greater velocity and displacement values than the plyo step technique. However, results from earlier studies have produced contrasting results. Frost, Cronin and Levin (2008) found that the plyo step sprint start technique was significantly faster than the forward step sprint start technique over the course of 1 days worth of testing. In a separate study, Kraan et al. (2001) found that 95 percent of athletes perform the plyo step sprint start technique as a natural reaction. This study suggested that the athletes should
be given a chance to train in any alternative methods in order to be comparable to the
plyo step sprint start technique. This study also suggests that in order to see any kind of
significant improvements in sprint times, a 6-week strength and conditioning program
should be incorporated into the athlete’s training. Furthermore, the forward step
technique had significantly faster sprint times following the 6-week sprint training
program in comparison to the plyo step technique.

Recommendations for Future Studies

Although there are few studies that look at the effects of sprint start techniques
(Frost, Cronin & Levin, 2008; Frost and Cronin, 2011; Kraan et al., 2001; LaDune et al.,
2012) on athletes, the findings are equivocal. None of the previous studies used
longitudinal training programs to get the athletes familiarized with different starting
stances before analyzing their results. Therefore, further research is needed to examine
the effects of different starting stances on other sports. This study was conducted on a
small population, specifically to junior collegiate football players. Other sports have
different needs and movement patterns to consider when taking off from an athletic
stance. A researcher might want to examine the lateral effects of a starting stance
technique for sports such as baseball and volleyball.

The next step in research might be to change the environment in which the
athletes train and test in. This study was practiced and performed on a football field.
Indoor sports such as, basketball and volleyball would benefit from testing the starting
stances on an indoor court or sports such as tennis on a solid surface, rather than a field.
APPENDIX A

Warm-Up

- 800m jog at talk pace
- Jog with arm swings (side to side) (overhead) (swimming action)
- Skipping rope action with small arm circles (forward & backward)
- Same action with big arm circles
- Jog (bending over to touch the ground as you go)
- Jog using fast short steps (quick arm action)
- Jog doing “cross-steps” (running sideways) with arms crossing
- Jog doing 6-8 reps “A skip”
- Jog doing 6-8 reps “A skip” (front and side)
- Jog doing 3-4 reps “B skip”
- Jog doing 8-8 reps butt kicks (heel to butt)
- Variation of drills (combination of A’s & B’s, double A-B)
- Walk 4 X 50m static/dynamic stretching (lunge, “A” march-hold, butt kick hold)
- Upper body strengthening (pushup, sit-ups, leg lifts)
- Walk on toes (toes in, toes out, hop – feet together)
- Jog slowly bending over to touch ground (3pt. start) and gradually accelerate 20-30, smoothly
- Jog doing 6-8 straight-leg bounds into an acceleration
- Falling acceleration for 30-40m (smoothly and relaxed)
- 2 X 50-80m controlled acceleration (key on proper running mechanics)
### APPENDIX B

A six-week speed training session for junior college football players

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monday</strong></td>
<td><strong>Thursday</strong></td>
</tr>
<tr>
<td>3X 10yd Acceleration</td>
<td>4X 10yd Acceleration</td>
</tr>
<tr>
<td>3X 15yd Acceleration</td>
<td>4X 20yd Acceleration</td>
</tr>
<tr>
<td>1X 20yd Acceleration</td>
<td>1X 30yd Acceleration</td>
</tr>
<tr>
<td>1X 25yd Acceleration</td>
<td>1:30-2:00 recovery</td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td><strong>Week 4</strong></td>
</tr>
<tr>
<td><strong>Monday</strong></td>
<td><strong>Thursday</strong></td>
</tr>
<tr>
<td>2X 15yd Acceleration</td>
<td>16X 110’s</td>
</tr>
<tr>
<td>2X 20yd Acceleration</td>
<td>Timed: 15, 17, 19 Sec</td>
</tr>
<tr>
<td>2X 25yd Acceleration</td>
<td></td>
</tr>
<tr>
<td>2X 30yd Acceleration</td>
<td></td>
</tr>
<tr>
<td>1:30-2:00 recovery</td>
<td></td>
</tr>
<tr>
<td><strong>Week 5</strong></td>
<td><strong>Week 6</strong></td>
</tr>
<tr>
<td><strong>Monday</strong></td>
<td><strong>Thursday</strong></td>
</tr>
<tr>
<td>2 Quarters</td>
<td>4X 10yd Sprint</td>
</tr>
<tr>
<td>4X 55 @ 7, 8, 9sec</td>
<td>4X 12yd Sprint</td>
</tr>
<tr>
<td>2X 60 @ 11, 12, 13 Sec</td>
<td>4X 15yd Sprint</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C

6-Week Conditioning Session Volumes

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Volume in Yards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70 60</td>
</tr>
<tr>
<td>2</td>
<td>70 1540</td>
</tr>
<tr>
<td>3</td>
<td>90 1760</td>
</tr>
<tr>
<td>4</td>
<td>240 1320</td>
</tr>
<tr>
<td>5</td>
<td>88 340</td>
</tr>
<tr>
<td>6</td>
<td>122 46</td>
</tr>
</tbody>
</table>

- **Monday**
- **Thursday**
REFERENCES


