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The Effect of Lateral Spacing on the Spring Start

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ABSTRACT

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Sprinters are always looking for an improvement in their time, from the gun going off until the finish. An effective start can lead to reaching top velocity sooner and a decreased finish time. New developments in starting blocks, more specifically the width of the starting block pedal, has allowed for variation in foot placement in the blocks. With the ability to change how wide an athlete can place their feet in the blocks, this study looked at trying to find an optimum spacing for college level sprinters. Thirteen Male College Sprinters (mean age = 23.08 years) participated in this study. Subjects self selected their longitudinal block spacing with 3 different lateral positions being tested. In position 1, the feet were placed as narrow as was allowed by the starting block, simulating the width of a traditional set of blocks. Position 2 was defined by the hip width of the individual, distance between right ASIS to left ASIS. Position 3 was the preferred foot width of the subject as determined by completing a vertical jump. Measurements of peak force on the blocks at the time of the start as well as time to 10 m were taken. Neither peak force nor time to 10 m were different between conditions ($p = .887$, $p = .135$). The normal condition, position 1 (20cm), was measured to be the narrowest width with position 3 (mean = 37.6cm) being the widest in all subjects. The use of wider pedals on starting blocks is a fairly new idea in track and field, and is something that many athletes have not had the chance to practice with. Since the older style of starting blocks only allowed for a narrow stance that is what track athletes have become accustomed to and could possibly explain why there was no significant difference seen between the 3 starting positions. More research should be done after a time of adaptation to the new starting blocks by the athletes.

Keywords – Starting Blocks, Peak Force, Time to 10 m, Lateral Foot Width

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Introduction

In the 2007 World Championships in Track and Field held in Osaka, Japan, the difference in time between first place and sixth place in the women's 100 meter dash was less than .1 seconds. With such a miniscule amount of time separating a gold medal from no medal at all, there is no room for error. An important piece of the 100 meter dash is the initiation of movement, or the start. The importance of the sprint start does not merely end when the sprinter leaves the blocks. The force, velocity and positioning of the body from the start have an effect on the acceleration phase of the sprint (9,10,12,16), and eventually the outcome of the race.

Different aspects of the start, such as angles of the hip, knee and ankle (6,9,10) angle of the pedals (5,6,12) and longitudinal spacing of the feet (3,6,7,15,16) have all been studied. One of the most common variables researched is the variance in the spacing from the starting line to the feet. The three common types of longitudinal spacing are the bunched, medium and elongated starts (1,3,7,9,15,16). The most common finding is that the medium longitudinal spacing of the feet in the starting blocks, which varies depending on the athlete's size, is shown to be the most effective at producing the greatest acceleration (1,3,7,15,16).

One area that has received little attention is the lateral spacing between the feet (8), primarily due to the fact that until recently, sprinters had only one option of block pedal width. In the past, all blocks were made with the block pedals being only as wide as the typical foot. Now a new starting block has been created which offers a wider pedal to vary the foot placement (Figure 3). This new starting block has come about due to recent research which tested a wider foot placement (8) (Figure 1). It reported that a wider lateral spacing (38cm vs. 24cm) produced a longer and more forward first step from the blocks than the traditional spacing (8) (Figure 2). This recent research also saw some differences in times to 5, 10, 20, and 30 meters though none were significant. More research is needed to determine optimal force production at different lateral spacing, as well as a method of finding the optimal spacing for each individual.

A common trend among weight lifters doing squats, power cleans, or snatches, as well as athletes being tested on vertical jump, is to place their feet at what would be considered hip or shoulder width apart (2,4,14,18). Particularly when performing a vertical jump, an athlete will self select a position for their feet to be in. This is a position that the athlete feels most comfortable, while being able to produce the greatest results. This may also apply to the sprint start, where an explosive reaction to the starting gun is critical. The application of foot placement in these exercises should then be applied to the athlete's specific sport. Being able to place a sprinter in a more powerful position in the starting blocks can benefit the start and the potential outcome. Therefore the purpose of this study was to compare 3 different lateral spacings in the starting blocks for collegiate male sprinters.

Methods

Subjects

Thirteen male members of the Brigham Young University (BYU) track team participated in this study (23.1 yrs ±3.0, 185.7 cm ± 1.3, 78.38 kg ± 10.5). The testing was done in March which coincides with the middle of the competitive season, which runs from January to June.

Instruments/Apparatus

All testing was done at the George Albert Smith Field House on the campus of Brigham Young University. The starting block used for the study was the Gill® Fusion I Starting Block (Gill Athletics, Champaign, IL) (Figure 3). Force was measured using a force plate (Kistler Corp., Model 9286BA Amherst, NY) which has been installed 10 meters before the finish line in lane 1 of the indoor track at BYU, which measures vertical, lateral and longitudinal force.

Brower® timing eyes (Draper, UT) were used to collect 10 m time, which records times to 1/1000 of a second.

Procedures

Testing consisted of three separate days, with a minimum of 24 hours separating the testing days. All participants completed and signed an informed consent form prior to their participation in the study. Each day consisted of the subject completing a prescribed dynamic warm-up designated by the coach. The warm-up typically consisted of some general running drills along with some dynamic stretching as well as some sprinting. This same warm-up routine would generally be consistent with what each athlete would do before a competition. Each subject would then complete six trials of 20 m. Each trial was a maximal effort with the subjects resting at least 5 minutes. Three trial starting widths were tested during the study with athletes self-selecting their own longitudinal spacing as well as their block pedal angle, with those settings being consistent throughout all trials. The three different positions were determined as follows (Figure 4): Position 1 (normal condition) was determined with the athlete placing their feet directly adjacent to the center rail of the starting blocks. This would be as narrow a stance as is allowed by the starting blocks similar to a normal set of starting blocks; position 2 was determined by the distance between the left and right anterior superior iliac spine (ASIS) of the athlete. This distance was recorded and then used as the distance between the second toes of each foot. Position 3 was determined by each athlete performing a vertical jump test administered by their strength and conditioning coach. The test subjects did three jumps with each jump being video recorded. From these three trials the average lateral spacing of their feet was used as position 3 for the starting block study. The subjects were then randomly assigned to either group A, B or C. Groups performed two trials of each position as shown (Table 1).

The starting blocks were placed directly on the force plate and measurements of resultant peak force and time to 10 m were recorded for each trial. Peak force was determined by an automated program that is able to find max resultant peak force from the time the gun is fired until the athlete clears the blocks. A false start, defined as a reaction time of less than 0.1 seconds, was not counted and the trial repeated.

Statistical Analysis

After normalizing resultant peak force to bodyweight and averaging each subject's 6 trials within each condition, two one way ANOVA's were used. The first to compare the dependent variable resultant peak force to the independent variable of foot placement and the second was used to compare the dependent variable of 10 m split time between the independent variable of foot placement. For all statistical procedures, $p \leq 0.05$ was used to determine significance.

Results

No differences were observed in peak force, normalized by body weight, between the three foot placement conditions ($p = .887$, Table 2). No differences were observed in 10-m time between conditions ($p = .135$, Table 2).

Thirteen male collegiate track and field sprinters participated in the study with 9 completing all of the required trials. The 4 subjects were not able to complete the trials due to injury either incurred during the testing or at some other time during their normal training sessions. Randomization was maintained with the 9 subjects that completed the study being evenly distributed between the 3 different conditions. The normal condition (position 1) (20cm) resulted in the narrowest foot width displacement in the blocks. The measurement of hip width (position 2) (25.5cm ± 1.78cm) was wider than the normal setting, and the vertical jump stance (position 3) (37.6cm ± 3.87cm) was the widest of the 3 conditions. Based on our testing, every subject's vertical jump stance was wider than their measured hip width (Table 3), and the hip width in all subjects was wider than the normal setting, which was 19cm for all subjects. Time to 10m as well as peak force at the start, were measured and results are given in Table 2.

Discussion

The results of this study showed no significant difference in peak force or time to 10 m when athletes used 3 different foot positions on the blocks. ($p = .579$, $p = .537$) For each subject, their vertical jump stance width was different from their hip width which differed from the normal block width position. One factor that may have contributed to this is the minimal difference between the three conditions. The average difference between the narrowest, or normal, stance and the widest, or vertical jump, stance for all subjects was 12.08 centimeters ± 3.58. These small differences in the width of the placement of the feet on the blocks may not have been wide enough to allow for a significant difference in the two dependent variables of 10-m time and peak force.

Due to the fact that each subject completed two trials of each starting width on one single testing day, there was a fairly high amount of variability seen on individual testing days (SD = .40), as well as between testing days (SD = .12). Each subject completed a total of 18 trials, with 6 being completed on one testing day. Although no measurements or statistical analysis were done on the mental attitude or physical fatigue of the subjects during testing these could be two possible factors that contributed to the amount of variance seen on testing days.

As pointed out earlier, the original track and field starting block had one option of foot spacing due to its narrow pedal. Because of this, athletes using older style starting blocks could only place their feet in what was considered the "normal" setting for this study. This became the accepted foot placement for starting blocks and therefore the most practiced. Due to the lack of other options, athletes have been trained as well as trained themselves to be proficient from this starting position. The inability and lack of practice in the hip width and vertical jump stance width positions in the starting blocks may have contributed to our findings of no significant differences.

The idea of “practice” could possibly be the biggest contributor to having no significant difference. It seems interesting that the “normal” position was not significantly more powerful and faster to 10 m than the other two positions. One might think with the amount of practice trials at the normal position that this would prove to be superior to the wider stances. Also, another variable that could be researched could be the stance that athletes feel the most comfortable in. For most this may be the normal width, but for some it may be something a bit wider. Further research on this matter could incorporate a period of practice at the wider placements prior to conducting the research.

When sprinters are accelerating from the blocks a common occurrence is the athlete stepping side to side rather than straight down the track, this is commonly referred to as wasted motion. When a sprinter is leaving the blocks and accelerating through the first 10 m they want to try and eliminate any wasted motion that is taking away from them moving straight down the track. The width of the feet in the blocks could be seen as a contributing factor to the athletes stepping out to the side more, rather than stepping straight. Again with practice at a wider stance, the athletes may be able to minimize the amount of wasted motion from stepping out to the side. This is one aspect that could be researched by its self. Comparing the different widths and seeing where the athletes are stepping while accelerating could have an affect on their time to 10 m.

Now that there is more availability to starting blocks with wider pedals, lateral foot displacement has a place in the discussion of coaching starts. Finding the optimal spacing that athletes should use in sprint starts is something that could be researched more. Incorporating a lengthy practice period prior to testing is something that could contribute to a difference among the different widths. Also incorporating looking at the step pattern, or how direct the athletes steps are straight down the track, as the athlete clears the starting blocks could also provide some data to support theories and results. Henson et. al. observed step pattern as subjects performed starts in their study. They noticed that the position 1 start position in their study (same as the normal position for this study) resulted with subjects first step having the most deviation from the center line and they also observed that the position 2 starting position resulted in the subjects having the longest step and most directed towards the finish. The lateral step, or "misstep", observed from the position 1 starting position by Henson supports observations accepted by most track coaches that in the conventional start athletes tend to step side to side instead of straight forward resulting in wasted motion (8). Focusing research on how the athletes take their first steps from the blocks and how it affects their time further away from the blocks could determine the importance of a wider foot placement.

Conclusion

Although there was not any significant difference found between the 3 starting positions from this study there are still some research possibilities. As shown in previous research conducted by Henson et. al., there were some significant differences in the 3 starting positions they used. As the newer, wider, blocks become more available and athletes more familiar with them, an improvement could be seen in a wider foot placement. Also the idea of athletes stepping directly out of the blocks as opposed to a side to side movement is an aspect that needs more attention. As far as whether or not athletes must have wider blocks is yet to be seen.

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Table 1: Testing procedures for the three groups

Group A:

	Position	Position	Position
Day 1	1	2	3
Day 2	2	3	1
Day 3	3	1	2

Group B:

	Position	Position	Position
Day 1	2	3	1
Day 2	3	1	23
Day 3	1	2	3

Group C:

	Position	Position	Position
Day 1	3	1	2
Day 2	1	2	3
Day 3	2	3	1

Table 2: Time to 10 meters and Peak Force Normalized to Bodyweight (mean ± SD)

	Normal	Hip Width	V-Jump
Time to 10 meters(s)	2.140 ± 0.100	2.153 ± 0.125	2.152 ± 0.112
Peak Force (BW)	2.019 ± 0.446	1.952 ± 0.433	2.056 ± 0.380

Table 3: Hip width and vertical jump stance width measurements

Subject #	hip width (cm)	v-jump (cm)
1	24	40
2	26	35
3	24	42
4	23	30
5	25	37
6	26	39
7	26	41
8	25	33
9	25	41
10	25	35
11	30	42
12	27	36

Figure 1: Blocks used for Henson research

Condition 1 **Condition 2** **Condition 3**

Figure 2: Conditions used for Henson research

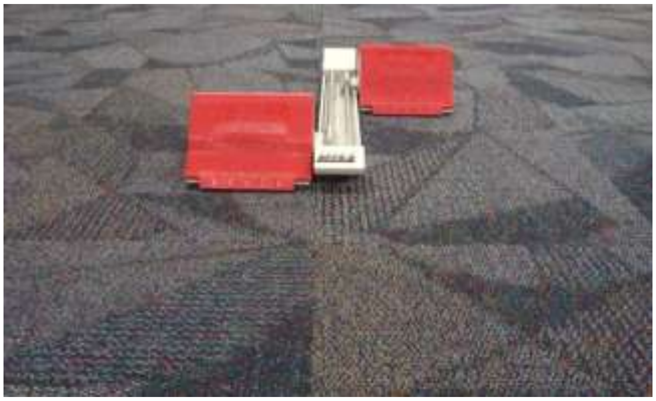

Figure 3: Gill Fusion Starting Block

Position 1 (normal)

Position 2 (hip width)

Position 3 (vertical jump)

Figure 4: The 3 different starting positions tested (the mean of each position is shown)

Appendix A

Prospectus

Chapter 1

Introduction

In the 2004 Summer Olympic Games held in Athens, Greece, the difference in time between first place and fourth place in the men's 100 meter dash was a mere .04 seconds. With such a miniscule amount of time separating a gold medal from no medal at all, there is no room for error. While there are many parts that comprise a 100 meter sprint, the start could quite possibly be the most researched aspect. The importance of the sprint start does not merely end when the sprinter leaves the blocks. The force, velocity and positioning of the body from the start have an effect on the acceleration phase of the sprint (8,9,11,14), and eventually the entire race.

Different aspects of the start, such as angles of the hip, knee and ankle, angle of the pedals, and longitudinal spacing of the feet, have all been looked at (1,3,5,6,7,8,9,13,14). The most common aspect researched is the variance in the spacing from the starting line to the feet, the three common types of longitudinal spacing are the bunched, medium and elongated starts (1,3,6,8,13,14). The most common finding is that the medium longitudinal spacing of the feet in the starting blocks is shown to be the most effective (1,3,6,13,14). With these findings we can now look at a different aspect of the placement of the feet in the starting blocks.

One area that has received little attention is the lateral spacing between the feet (7). A contributing factor to the reason for this lack of interest is due to the fact that until recently sprinters had only one option of block pedal width. In the past, all blocks were made with the block pedals being only as wide as the typical foot. Now a new starting block has been created which offers a wider pedal to vary the foot placement. This new starting block has come about due to some recently done research which found that athlete's times to 5, 10, and 30 meters was significantly faster with a wider foot placement. This research also showed that a wider lateral spacing produced a longer and more direct first step from the blocks than the traditional spacing (7). However more research needs to be done to look into the amount of force produced at different lateral spacing, as well as a method of finding the optimal spacing for each individual.

A common trend among weight lifters doing squats, power cleans, or snatches, as well as athletes being tested on vertical jump, is to place their feet at what would be considered hip or shoulder width apart (2,4,12,16). This may also apply to the sprint start, where an explosive reaction to the starting gun is critical. The application of foot placement in these exercises should then be applied to the athlete's specific sport. Being able to place a sprinter in a more powerful position in the starting blocks can benefit the start and the potential outcome.

Statement of the Problem

The purpose of this study is to find the optimal lateral foot separation in starting blocks for the most effective sprint start in male college-aged track and field sprinters by measuring force production at the start, the time it takes to reach peak force, and the time to 10 meters.

Hypothesis and Null Hypothesis

The displacement between an athlete's two feet when performing a vertical jump and replicated in sprinting starting blocks will result in an increase in peak force, a decrease in time to peak force and a decrease in 10 m split time in sprinting when compared to a traditional, more narrow, lateral foot placement in the starting blocks.

There will be no difference observed in peak force, time to peak force and 10 m split time between different lateral spacing in sprint starts.

Operational Definitions

Starting blocks—The device used to push against at the start of a sprint race in track and field.

Block pedal—Where one foot is placed on the block at the start. One set of blocks consists of two pedals attached to a rigid base.

Acceleration phase—The transition phase from the start of the sprint to when the athlete has reached their top speed, this is the first 20 to 40 meters of the sprint.

Assumptions

1. It is assumed there will not be any meaningful differences in performance between testing days.
2. It is assumed that the athletes have prior experience in vertical jump, enabling them to place their feet in the most optimal position for them.
3. It is assumed that each track athlete has their own longitudinal spacing already determined
4. It is assumed that each athlete has knowledge and experience in sprint starts and is familiar with the commands and procedures.

Delimitation

1. This study will be limited to Division I male track and field sprinters

Limitation

1. The athletes body position at the 10 m timing device may affect the precision of the time.

Significance of the Study

Sprinters in track and field are always searching for an edge on the track. New technology is always being invented, whether it is the surface of the track, the running spikes, or a change in starting position. Being able to use new technology properly can improve performance.

Currently at National and International Championships in track and field, athletes are required to use the starting blocks that are supplied. In the majority of these competitions the starting blocks used are the "older" model that has pedals that are only the width of a person's foot. With the institution of the "new" blocks there is now an option as to how wide you can place your feet on the blocks. More information on this matter could promote the championship competitions to have these blocks so the athletes can choose how they want to place their feet.

Chapter 2

Review of Literature

Since the invention of the starting blocks in 1928-29 by coaches George Breshnahan and William Tuttle, discussion on the optimal starting positioning has been a subject in the track and field world. Much research has been done on the sprint start, with the majority of it focusing on the longitudinal displacement between the front and rear feet. There have also been other criteria looked at, including hip and knee angles, as well as angle of the pedals. However, little research has been done to determine the effect that lateral foot placement on the blocks has on the start.

When athletes attempt a standing jump, or take a stance to perform a power clean or snatch, whether for training or testing, they are never required to have their feet a certain distance apart. This is not so in a sprint start, which can be viewed as very similar to these explosive exercises. In a sprint start with the conventional set of starting blocks the athletes have a predetermined lateral separation between their two feet, with possibly minute variations. It therefore seems that the application of these explosive exercises, applying to width of stance, can be implemented in the sprint start. Allowing the individuals to have their feet placed wider than a normal set of blocks will allow, could possibly be an advantage to the sprinter.

Earlier biomechanical researchers that have investigated the sprint start have come to a few general conclusions when talking about the position of the starting blocks in relation to acceleration and starting speed. First, it is felt that for the most effective sprint start, the initial thrust must be powerful, and the angle of the body leaving the blocks should be as low as possible. Second, for a quick reaction, the body weight should not be transferred too much on to the hands, this could prolong the reaction time by as much as .05 to .15 seconds. Thirdly, that the medium starting position will produce the fastest acceleration, since in this position a balance between the requirements for a powerful thrust and a position, which will lead smoothly into the sprint, is obtained. (1,3,6,13,14) The medium starting position is defined by Hoster (8) as the front foot being 30-50 cm away from the starting line and the back foot 75-90 cm away from the starting line.

When referring to the sprint start it is commonly recognized that there are three different starting positions: the bunched, medium and elongated start. The bunched start places the sprinter closer to the starting line while also having the feet longitudinally closer together in the blocks. The bunch start is believed to allow the sprinter to leave the blocks quicker, however it may not position the sprinter correctly for the acceleration phase of the sprint (6). The elongated start has the sprinter positioned the furthest away from the starting line, with the longitudinal separation of the feet being the greatest as well. The elongated start is seen to position the sprinters body more appropriately, but the amount of force is greatly decreased from this position, thus not allowing for a powerful, explosive start. The medium start has widely been accepted to be the most appropriate position for the sprint start. It combines both the bunched and elongated starts in that it properly positions the body and also allows for a powerful, explosive push from the blocks. Along with the longitudinal spacing of the blocks more recent research has begun to investigate the angle at which the block pedal is placed (11). Findings have shown that a lower block angle produces a greater take-off velocity from the blocks (5,11). With the majority of the research findings supporting the medium start and a lower block angle, it seems necessary to look at other aspects. This is why we will look into the effect of changing the lateral spacing between the feet.

The research done on the lateral placement of the feet in starting blocks is limited. This opens up great opportunities when looking at this dimension of the sprint start. One of the widely seen problems in athletes, at the start of the sprint, is the location that they are striking the ground for the first few steps of their start. Many athletes initial movement is to step out laterally toward the edge of the lane instead of directly forward toward the finish line. This is referred to as a “miss step” or an athlete’s attempt to regain balance (7). This lateral movement, or miss step, occurs for the first few steps from the blocks until the sprinter feels they are balanced and starts stepping towards the middle of the lane, directly below their hips. It is believed that by starting with their feet in a wider position in the blocks this lateral movement can be eliminated, and more efficient movement can be made toward the finish line.

The concept of “driving” out of the blocks straight, has been, and can be learned with a narrow foot placement. Athletes have been trained to position themselves in the proper manner as to accelerate the quickest. If the “good” athletes do not have a problem with stepping out laterally then why is it necessary to change the lateral foot placement? As discussed earlier, there have been numerous amounts of research done that have involved the testing of vertical jump. When the subjects were required to test their vertical jump, they were never required to place their feet a certain distance apart. Therefore, each subject would have put their feet in a position they felt most comfortable, and they could have the ability to be the most explosive. Also when athletes are doing weight training that involves power cleans and snatches, they are not required to have their feet a certain distance apart. The point being that each individual will place their feet in a position that is most suitable or comfortable for them. This usually ends up being about hip or shoulder width apart. Why then would this not apply to the sprint start? Currently athletes are required to have their feet in a position that is mandated by the starting blocks provided by the competition at which they are competing. Therefore, there is a restriction as to the lateral spacing that can be obtained by the provided starting blocks. It appears that if the athletes were able to place their feet at a desired width, they would be able to produce more force onto the block. This greater production of force could ideally produce greater power and in the end faster times. It appears that this could be of benefit to sprinters looking for even more of an edge.

Of the research done on this matter of lateral foot placement in the starting blocks, the investigators initially looked at three different settings. Henson et al. (7) initially took a standard set of starting blocks and had them modified so there were three pedals adjacent to each other on each side of the starting block (fig. 1). The initial thought was to compare the use of the three different widths by having the feet placed on either the inner, middle, or outer pedals. The outer pedals were soon deemed too wide and not used at all in the study. They then decided to use three different spacings, but by only using the inner and middle pedals. The lateral toe-to-toe spacing used for the three different trials were:

Condition 1/Conventional—24 cm, this is the use of the inner pedals

Condition 2/Intermediate—38 cm, the subjects placed their foot between the first and second pedal

Condition 3/Lateral—52 cm, the subjects placed their foot on the second pedal (Fig. 2) (7)

They concluded that the intermediate position was the best, based on the data that this position produced the fastest times at 5 meters, 10 meters and 30 meters from the start (7). This research is a good starting point to find more specific modifications that can be made, including how wide apart should the feet actually be.

Knowing that an "intermediate" lateral foot placement in the starting blocks has been demonstrated to be more effective, a more precise method is now needed. Using the same lateral feet displacement in starting blocks that is used in the performance of a vertical jump is just a starting point. If any information is gained from this study, other aspects should be researched. The use of anthropometric measurements would be of great benefit when dealing with this type of research. Each individual's muscles and joints differ in size, length, and places of attachment. These measurements could have a factor on what would be the most efficient starting position for each individual. This is demonstrated in the study performed by Mero et al. (11), when testing the angle of the pedals and how that varies the muscle tendon length. Other factors such as strength and ability to produce power can also be factored in, to determine the optimal position. The possibilities seem limitless when dealing with the positioning of the feet in the starting blocks.

Athletes that are involved in powerful and explosive type movements can usually be found spending many hours in the weight room. The track, field, or court usually are places where athletes go to sharpen their game and skills and the weight room is where they go to increase their strength and power. Two critical exercises that these athletes are found doing are the power clean and the snatch. These are two exercises that help an athlete attain their maximum power. The power clean can increase an athletes rate of force development, peak power, and speed as well as teach an athletes muscles to react explosively (2,12). All of these aspects of the power clean are mirrored in the sprint start and should therefore be seen as a beneficial exercise to the sprint start. The movement involved in the power clean producing major body segment extension characteristics is identical to a runner propelling themselves from the start (12). Since maximal loads can be lifted in the power clean and there has been a strong correlation between maximum strength and sports performance shown in prior studies, the power clean is beneficial in sport (15). An exercise that can be shown to have such similarities with an explosive activity such as the sprint start should then be considered when positioning is considered. This is why it is important to be able to have a variation on the width of stance within the starting blocks. When performing a snatch or clean, the width of the stance should ideally be determined empirically, but should be approximately the same as the position from which a vertical jump is performed (16). This positioning allows for an athlete to obtain a foot placement that is comfortable to them, as well as able to implement previous training in the power clean and snatch. Allowing the athlete to vary the width of their stance in the starting blocks could potentially produce their most powerful outcome.

Elite athletes have gone to numerous measures to improve their performance. All one has to do is look at the prevalence of performance enhancing drugs among world class athletes. Although the thought of accounting for individual characteristics when determining what is the best starting position, seems as if you are going overboard. It appears that the use of anthropometric measurements can be a great determinant for lateral foot spacing in starting blocks. Any advantage that can be found to improve the performance of these athletes will be welcomed by all, especially when it is only .04 seconds separating no medal and a gold medal.

Chapter 3

Methods

Subjects

A minimum of nine male members of the Brigham Young University (BYU) track team will participate in this study. The testing will be done during the middle of the entire training season, which runs from September to June.

Instruments/Apparatus

All testing will be done at the George Albert Smith Field House on the campus of BYU. The starting blocks that will be used for the study are the Gill® Fusion I Starting Blocks (Gill Athletics, Champaign, IL). Force will be measured using a force plate (AMTI OR-6, Watertown, MA) which has been installed 10 meters before the finish line in lane 1 of the indoor track at BYU, which measures vertical, lateral and longitudinal force. Reaction time will be measured by the Finishlynx ReacTime® timer (Haverhill, MA) positioned on the starting blocks. Finishlynx® timing eyes will also be used to collect the 10 m time. Both devices record times to 1/1000 of a second.

Procedures

Before doing any sprint starts for the study, each athlete will do a vertical jump test administered by their respective strength and conditioning coach. The test subjects will do three jumps with each jump being video recorded. From these three trials the average lateral spacing of their feet will then be used as position 3 for the starting block study.

Testing will consist of three separate days, with a minimum of 24 hours separating the testing days. All participants will complete and sign an informed consent form prior to their participation in the study. Each day will consist of the subject completing six trials of 30 meters.

Each trial will be a maximal effort with the subjects resting 5-10 minutes, or until they feel capable of completing another maximal trial. Three trial starting widths will be tested during the study and the athletes will self select their own longitudinal spacing as well as their block pedal angle. The three different positions will be determined as follows: Position 1 will be with the athlete placing their feet directly adjacent to the center rail of the starting blocks. This would be as narrow a stance as is allowed by the starting blocks; position 2 will be determined by the distance between the left and right anterior superior iliac spine (ASIS) of the athlete. This distance will be recorded and then used as the distance between the center of both feet, defined as the second toe; position 3 will be determined from the vertical jump testing as mentioned above. The subjects will be randomly assigned to either group A, B or C. Groups will then perform two trials of each position as shown (Table 1).

Measurements of reaction time, resultant peak force, time to peak force, and time to 10 meters will then be recorded for each individual for each trial. Peak force will be determined by an automated program that is able to find max resultant peak force from the time the gun is fired until the athlete clears the blocks. Time to resultant peak force will be the time from when the gun is fired to the time of resultant peak force minus the reaction time. A false start, defined as a reaction time of less than 0.1 seconds, will not be counted and the trial will have to be done again.

Table 1: Testing procedures for the three groups

Group A:

	Position	Position	Position
Day 1	1	2	3
Day 2	2	3	1
Day 3	3	1	2

Group B:

	Position	Position	Position
Day 1	2	3	1
Day 2	3	1	2
Day 3	1	2	3

Group C:

	Position	Position	Position
Day 1	3	1	2
Day 2	1	2	3
Day 3	2	3	1

Statistics

Repeated measures ANOVA with post-hoc tests will be used to compare the dependent variables resultant peak force, time to resultant peak force and 10 m split time between the independent variables of foot placement. Time to resultant peak force will be defined as the time from when the gun is fired to the resultant peak force and then subtracting the reaction time. This can all be determined from the information gained by the force plate.

Figure 1. Caption

Condition 1

Condition 2

Condition 3

Figure 2. Caption

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