Waterford Institute of Technology
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‘The effects of a Razor Curl and Nordic Drop training intervention on absolute, relative and isometric strength development in soccer players’

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A project submitted in part fulfilment of the requirement for the BSc in Sports Coaching and Performance

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Statement of originality and ownership of work

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I confirm that all the work submitted in this project is my own work, not copied from any other person's work (published or unpublished) and that it has not previously been submitted for assessment on any other course, in any other institution.

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List of Abbreviations

Iso MTP = Isometric Mid-Thigh Pull (KG)

Deadlift =3RM Deadlift (KG),

GBR = Single leg Glute bridge right,

GBL = Single leg Glute bridge left.

T =T Stat

P = P value

Abstract

Overview: Regular implementation of the Nordic Drop in training regimes (knee dominant exercise) has been evaluated tenfold and increases in hamstring strength have been the result therefore reducing the risk of injury. Razor Curl exercise (hip and knee dominant) has been seen in literature but not implemented in training regimes as prominently as the Nordic Drop to increase hamstring strength. **AIM:** The aim of this study is to evaluate the effects of a Razor Curl and Nordic Drop training intervention on absolute, relative and isometric strength development in soccer players and evaluate which exercise shows greatest benefits in hamstring strength. **Participants:** The study will include 12 male soccer players. **Design:** Experimental design. Two groups One Nordic drop intervention and One Razor curl intervention. The programme was completed two days per week over 6 weeks, total of twelve sessions. **Result:** In the Nordic drop group there was significant difference found in Isometric mid-thigh Pull ($t = -3.76$, $p = < 0.01$), GBR ($t = -4.15$, $p = < 0.00$), GBL ($t = -2.98$, $p = < 0.03$). There was no significant difference found in the deadlift ($t = -2.24$, $p = > 0.07$). In the Razor curl group there was significant difference found in Isometric mid-thigh Pull ($t = -8$, $p = < 0.00$), Deadlift ($t = -5.56$, $p = < 0.00$), GBL ($t = -3.00$, $p = < 0.03$). There was no significant difference found in the GBR ($t = -2.15$, $p = > 0.08$). **Conclusion:** The results indicate both Nordic Drop and Razor Curl can be effective in a training intervention as each other for improving strength. Implementing strength programmes with hamstring strength exercises may be key in preventing injuries

Chapter one

1.0 Introduction

Participating in sport has well known benefits in health but is also associated with the risk of injury. Sporting injuries occur either during training or competition and can affect any type of musculoskeletal connective tissue and are categorised as being either acute or overuse based on the mechanism of injury (sprinting or stretch) and rapidly of symptom onset (Brunker & Khan, 2017). The Biceps Femoris is the most commonly injured muscle with 53 – 68% of injuries occurring during sprinting (Opar & Williams, 2012). In soccer many injuries occur but the most prevalent is in the hamstring muscle group (Woods et al., 2004). Woods et al. (2004) discovered 12 % of injuries were hamstring strains an average of 5 injuries per club per season. As a result of these injuries a total loss of participation time was 13,116 hours and 2,029 matches were missed due to hamstring strains, giving an average of 90 days and 15 matches per club per season. Ekstrand, Waldén & Hägglund (2016) found in a 13 year study hamstrings injuries in professional soccer has increased by 4% annually since 2001. Crosier et al. (2008) and Petersen et al. (2011) found strength imbalance a high risk for injury in soccer players. Increasing hamstring strength using an eccentric strength programme utilizing the Nordic drop prevented injury from occurring. However Guex et al. (2013) proposed when choosing an exercise for hamstring strengthening the focus should be on high-load eccentric contractions at the knee joint and to keep the hip in a large flexion position 80 degrees in order to reach a greater ‘‘elongation stress’’ than in the terminal swing. This training method has athletes trained to decelerate the knee extension more effectively in full range of motion and not overstretch the hamstring muscle. Research is limited in this area although Oliver and Dougherty (2009) have seen implementing the Razor curl as functional way to strengthen the hamstrings in multifactorial sports. The aim of this study is to see the effects of a Razor Curl and Nordic Drop training intervention to see if absolute strength changes using 3 rep max Deadlift as a measure (Baechle & Earle,2008), relative strength changes using the Single Leg Glute Bridge on the right leg (GBR) and Single Leg Glute Bridge on the left leg (GBL) as a measure

(Freckleton, Cook & Pizzari, 2014) and isometric strength using Isometric Mid-Thigh Pull (IMTP) as a measure (Wang et al., 2016).

Chapter Two

2.0 Literature Review

2.1 The Function of the Hamstrings

Novacheck (1998) describes the role of the hamstrings is to decelerate knee extension during the late swing phase and to extend the hip in the second half of the swing and first half of the stance. The terminal and swing phases have been outlined as the point where injury is most likely to occur in the hamstring (Woods et al., 2004). Schache et al. (2012) shows that between 75% and 85% of the running cycle, hamstrings are undergoing the lengthening eccentric contraction. Furthermore Wood et al. (1993) suggests that repetitive eccentric contractions have the ability to cause injury in the hamstring.

2.2 Physiological demands of Soccer

According to Di Salvo et al. (2007) understanding the physiological load imposed on top level soccer players in reference to their position during competitive matches (activity profile, distance covered, intensity, energy system and muscles involved) are necessary to develop a sport specific training protocol or programme. Similarly Bloomfield, Polman and O'Donoghue (2007) agree with Di Salvo et al. (2007) that the management of the physical and physiological status of elite soccer players relies on detailed knowledge regarding the demands of the sport.

Soccer involves frequent fluctuations between high and low intensities so demands are very high on the athletes (Mohr, Krustrup and Bangsbo, 2003). Mohr, Krustrup and Bangsbo (2003) examined match performance in high soccer players outlining top class players cover distances of 10-11km per game with top class players covering more distances at lower and higher intensities but also elite soccer players completing 150-250 intense actions per game, this indicates high anaerobic nature of soccer. Research conducted by Di Salvo et al. (2007) shows similar physiological demands in soccer with results showing elite level soccer players covering on average 11 km in total distance per game. Findings also show through a time motion analysis that different positions cover different distances at different intensities. Central defenders covered less distance than any other position, external defenders

and forwards worked at same intensities and covered same distances, central midfielders covered the most distance between 11km-19km whereas external midfielders covered the highest distance at intensities 19km and higher. Although soccer has an anaerobic component, Bangsbo (1994) estimated that aerobic metabolism provides around 90 % of the energy cost of match play. These intensities are due to purposeful movement and the performance of soccer specific skills (Drust, Atkinson & Reilly, 2007). Due to these demands many studies have looked at increasing strength using the eccentric exercise the Nordic Drop which could be a protective factor (Askling et al. (2003),Guex et al., (2016), Rey et al.(2017), Mjølsnes et al., (2004).

2.3 Eccentric training preventing injury

Askling et al. (2003) evaluated whether a preseason strength programme for the hamstring muscle group emphasising eccentric overload can help prevent an injury from occurring and if so the severity of the injury. The results of this study illustrated occurrence of hamstring injuries were clearly lower in the training group with 3/15 than in the control group where they had 10/15. This demonstrated strength and speed were increased in the training group which is another benefit. The utilization of the Nordic Drop hamstring exercise is prominent in literature. Rey et al. (2017) examined Nordic Drop hamstring exercise in elite junior soccer players and found significant strength improvements. The intervention consisted of two groups Nordic drop group and the Russian belt exercise group. A significant improvement ($p<0.001$) was found in both groups when testing single leg hamstring bridge test pre and post intervention. Testing for imbalances is very important in soccer as Tsepis, Vagenas, Giakas & Georgoulis (2004) found lower limb asymmetries can be linked to injury. Mjølsnes et al. (2004) provided a 10 week intervention where they examined the Nordic Drop in well trained soccer players and similar to Rey et al. (2017) results discovered a significant improvement in strength. Subjects were split into two groups, Nordic Drop group and Hamstring curl group and completed similar programmes. The Nordic Drop displayed significant results in increasing strength. The concentric hamstring curl exercise group seen no significant difference in strength illustrating 10 week eccentric programme is more effective for increasing hamstring strength in well trained soccer players. According to Mjølsnes et al. (2004) the Nordic Drop hamstring exercise can also help significantly improve strength in

hamstring muscle and also improve Quadriceps: Hamstring ratio as there is no effect on concentric quadriceps strength. Gabbe, Branson and Bennell (2006) found considerations such as Delayed Onset Muscle Soreness (DOMS) when examining eccentric strength for injury prevention. The study demonstrated using eccentric training can reduce injuries but delayed onset muscle soreness (DOMS) did have an effect of some participants wanting to complete the session.

2.4 Concentric vs Eccentric

Askling et al. (2003),Guex et al., (2016) and Rey et al.(2017) have shown that eccentric knee flexor training reduces hamstring injuries by implementing eccentric strength regimes. The benefits of this type of training are likely to be mediated by increase in Bicep Femoris length long head fascicle and eccentric knee flexor strength. Bourne, Opar, & Shield (2016) examined muscle activation patterns in 10 men with previous hamstring injury using the Nordic Drop exercise. The findings found the most injured site in hamstring muscle injury is the Bicep Femoris yet Bourne et al. (2016) showed the Semitendinosus displayed higher levels of activation when performing 6 sets of 10 repetitions of the Nordic Drop which reflects the amount of muscular effort when performing the exercise. Semitendinosus requires a lot of muscular effort this suggests that other exercises may be optimal for preventing injury in the Bicep Femoris. Bourne, Williams, Opar, Al Najjar, Kerr, and Shield (2016) support the stance on Nordic Drop preferentially recruiting the semitendinosus and found eccentrically the largest Bicep Femoris activation occurred during hip extension exercises and concentrically highest muscle activation was in the lunge and exercises with hip extension example being the glute ham raise.

Bourne, Timmins & Opar (2017) reported implementing exercises with a combination of hip and knee action are more effective when targeting all heads of the hamstring. Exercises such as Russian deadlift, stiff leg deadlift and hip extension were shown to have more muscle activation than knee dominant exercises. Oakley, Jennings and Bishop (2017) as they suggest hip and knee dominant exercise are to be taken into account while implementing a strength programme as they outline during the late swing phase of running, the Biceps Femoris and other hamstring muscles function is to eccentrically resist hip flexion and decelerate knee. During this action the

hamstring undergoes large ranges of motion and different activation patterns suggest that although exercises are beneficial in building hamstring strength the contractions occur at a much slower rate than during sprinting and athletes should also be exposed to progressive high speed running. Oakley, Jennings and Bishop (2017) show implementing hip and knee dominant exercises are more effective than just using knee dominant exercises. The Razor Curl is an exercise that will try to strengthen the muscle in the concentric (shortening) phase and eccentric (lengthening) phase of a muscle contraction. Oliver & Dougherty (2009) found maximal activation of the hamstrings and gluteus were attained using the Razor curl at 90 degrees of hip flexion to the point of knee flexion beyond 90 degrees and allows the athlete to assume athletic functional posture while optimally training the hamstrings.

The intervention according to Baechle & Earle (2008) training frequency should be 2-3 times per week, also with the goal been strength no more than six repetitions and sets ranging from 2-6 sets with rest periods of two-five minutes. Cheung, Hume & Maxwell (2003) stated that delayed onset of muscle soreness peaks 24-48 hours after exercise and subsides with 4 days. Participants completed two sessions a week four days apart to ensure session is not starting with fatigued muscle groups. Training principle overload and progression was applied in the programme. Baechle & Earle(2008) state Overload is assigning a training programme of greater intensity than the athlete is accustomed to and when this principle is applied over training is avoided and the desired training effect will have effect but also needs progression to keep producing higher levels of performance and in order to do this intensity needs to become progressively greater. Deadlift using 3 rep maximum is shown by Baechle and Earle (2008) to be an effective lower limb strength test when evaluating athletic performance. Muscular strength changes using the Single Leg Glute Bridge on the right leg (GBR) and Single Leg Glute Bridge on the left leg (GBL) as a measure was show to be reliable when assessing muscular strength and was validated by Freckleton, Cook & Pizzari (2014). Isometric strength using Isometric Mid-Thigh Pull (IMTP) exercise was evaluated by Wang et al. (2016) and shown to have significant relvance when testing Isometric strength for athletic performance.

Askling et al. (2003),Guex et al., (2016), Rey et al.(2017) and Mjølsnes et al. (2004) literature favour implementing Nordic Drop for eccentric strength development.

Oakley et al. (2017), Bourne et al. (2016) and Oliver & Dougherty (2009) literature favour exercise that use hip and knee combination as they are more effective in reaching all parts of the hamstrings. The aim of this study is to evaluate the effects of a Razor Curl and Nordic Drop training intervention on absolute, relative and isometric strength development in soccer players and evaluate which exercise shows greatest benefits in hamstring strength.

Chapter Three

3.0 Methodology

3.1 Subjects

The aim is to see the effects of a razor curl and Nordic Drop strength intervention to see strength improvements in lower limb absolute, isometric and muscular endurance in soccer players. Twelve male soccer players were included in the study and were matched into Nordic Drop group or Razor Curl group from there 3RM deadlift to avoid a strength bias group. Six subjects were then put into Nordic Drop group and six subjects were put into Razor Curl group. All subjects involved were informed of the risks but also the benefits of participating in this experimental procedure. All participants signed consent forms before the study commenced and institutional ethics were received from the Department of Health, Sport and Exercise Sciences School of Health Sciences. Soccer players from the county U19 soccer team Waterford FC were recruited. Any players who were injured currently, medical problems that may have affected performance or under the age of 18 were excluded from the study. All participants were aware that withdrawal at any time from the programme was accepted.

3.2 Testing procedures

Each participant completed a 10 minute warm up consisting five minutes of jogging and 5 mins of dynamic stretches (Quad, gluteus, Hamstrings and calves).The single leg Glute Bridge (SLGB) was used to test the participant's pre and post intervention to measure Muscular endurance. The test started with participants laying flat on the ground with their right foot on 60 cm box and left foot vertical to avoid assistance to the leg doing the work. The participant completed as many repetitions to failure as possible on the Single leg Glute bridge right (GBR) before switching to test the Single leg Glute Bridge left leg (GBL). This showed any asymmetries in the participant's lower limb strength if they scored differently on each leg. Each participant started the procedure on the opposite leg to the previous participant.

The Mid-thigh pull test started with the participant standing upright on the base of the dynamometer. Distance from greater trochanter to lateral epicondyle was measured

and halfway between the two points was where each participant initiated the pull. The participant was guided to put his feet in the correct position on the platform and instructed to let arms hang straight down to hold the bar with both hands with an overhand grip. The knees were bent at 110 degrees and the participant had their back foot forward and looking straight ahead. When the participant was positioned correctly they were instructed to pull hard as possible on the chain and straighten their legs with their arms straight. Each participant was given one attempt for familiarisation and one recorded attempt.

The three repetition max Deadlift was completed using the standards outlined by the NSCA. The participant was instructed to place both feet under hips with hands placed on the bar outside of the lower limbs. The participant was then instructed to lift the bar with braced core by extending the hips and knees until the body reached a full erect torso position.

3.3 Intervention

The study was an experimental research design. Both groups were matched before given a strength training programme to prevent a strength biased group. Participants were separated into Nordic Drop group and Razor Curl based of their cumulative score of the 3 RM Deadlift.

The Razor Curl group performed an exercise that will try to strengthen the muscle in the concentric (shortening) phase and eccentric (lengthening) phase of a muscle contraction. The Nordic Drop group performed an exercise to try strengthen the muscle in the eccentric (lengthening) phase. This group performed the movement isolating the hamstring in their strength programme.

The control group Nordic Drop: The athlete began in a kneeling position and gradually lowers their bodyweight towards the ground extending at the knee while contracting the knee flexors eccentrically to slow the descent and during this exercise the athlete's ankles can be held down by a partner.

The experimental group Razor Curl: The athlete started in kneeling position. Both hips went to 90 degrees. Once in start position, the athlete extended at the hip and knee once extension was reached the athlete returned to the starting position to complete the repetition.

The programme was implemented with a current training regime that is taking place. The programme was completed two days per week over 6 weeks, total of twelve sessions. The testing was completed at Waterford Institute of Technology in the sports performance department. The programme began after testing and participants were retested after the six weeks. The intervention programme was completed in the RSC gym.

3.4 Programme

Nordic Drop		
Week 1-3	Week 4	Week 5-6
Monday & Friday	Monday & Friday	Monday & Friday
3 sets 6 repetitions	2 sets 6 repetitions	4 sets 6 repetitions
Rest 3 minutes between sets	Rest 3 minutes between sets	Rest 3 minutes between sets

Razor Curl		
Week 1-3	Week 4	Week 5-6
Monday & Friday	Monday & Friday	Monday & Friday
3 sets 6 repetitions	2 sets 6 repetitions	4 sets 6 repetitions
Rest 3 minutes between sets	Rest 3 minutes between sets	Rest 3 minutes between sets

3.5 Ethical Considerations

All participants were over 18 years old. All participants were informed of risks of study and aware they could withdraw at any time. Injury occurrence or pain was outlined that it would lead to withdrawal from study. All data was stored and protected with a password.

3.6 Statistical Analysis

Using Microsoft excel all three exercises were analysed pre and post intervention to determine if a statistical difference could be discovered. Significance level is set at $p < 0.05$. All data is reported as means ± standard deviation (SD). The Shapiro-wilk test was applied in order to access normality. Paired T test was carried out on both groups for each exercise to find a statistical significance pre and post for all three exercises including Single leg Glute Bridge left and right leg. Independent T test was carried out to find a statistical significance in all three exercises post intervention. For pre intervention both groups were evenly matched from testing and were put into two groups of six for the training programme based on scores collected from the absolute strength 3RM deadlift score.

3.7 Research Questions

Will the Nordic Drop increase absolute, isometric and muscular strength in 6 week training intervention?

Will the Razor Curl increase absolute, isometric and muscular strength in 6 week training intervention?

Which exercise could potentially result in greater strength benefits?

Chapter Four

4.0 Results

The aim of this study was to examine the effects of a Razor Curl and Nordic Drop training intervention on absolute, relative and isometric strength development in soccer players and explore which exercise showed greatest benefits for strength increase. Data was found to be normally distributed through a Shapiro-Wilk test. The overall difference in Nordic Drop group is represented in Table 1. The Nordic Drop descriptive statistics pre and post mean ± SD are illustrated in chart format in Figure 1. The overall difference in Razor Curl group is represented in Table 2. Razor descriptive statistics pre and post mean ± SD are illustrated in chart form in Figure 2. Paired Sample T-Test results for pre and post Nordic Drop group are outlined in Table 3. Paired Sample T-Test results for pre and post Razor Curl group are outlined in Table 4. Independent T test score for post Nordic group vs post Razor group is illustrated in Table 5. In the Nordic Drop group there was significant difference found in Isometric MTP ($t = -3.76$, $p = < 0.01$), GBR ($t = - 4.15$, $p = < 0.00$), GBL ($t = -2.98$, $p = < 0.03$). There was no significant difference found in the deadlift ($t = -2.24$, $p = > 0.07$). In the Razor curl group there was significant difference found in Isometric MTP ($t = -8$, $p = < 0.00$), Deadlift ($t = -5.56$, $p = < 0.00$), GBL ($t = -3.00$, $p = < 0.03$). There was no significant difference found in the GBR ($t = -2.15$, $p = > 0.08$).

Table 1. Nordic Drop (mean ± SD and percentage change).

Exercise	***Pre***	***Post***	***% Change***
Iso MTP	132.17 ± 13.52	140.83 ± 13.04*	6.6
Deadlift	91.67 ± 13.74	94.17 ± 11.70	0.3
GBR	20.17 ± 3.02	23.50 ± 3.59*	16.5
GBL	20.33 ± 4.07	22.00 ± 4.00*	8.2

Iso MTP = Isometric Mid-Thigh Pull (KG) Deadlift =3RM Deadlift (KG), GBR = Single leg Glute bridge right, GBL = Single leg Glute bridge left. Mean ± SD and percentage change.

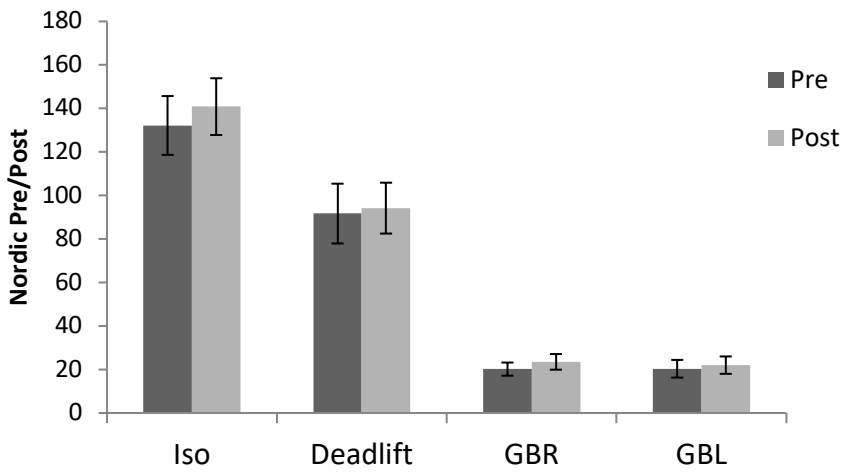

Figure 1: Nordic Drop pre and post data represented as mean and standard deviation.

Table 2. Razor Curl (mean ± SD and percentage change).

Exercise	***Pre***	***Post***	***% Change***
Iso MTP	138.33 ± 16.24	151.67 ± 13.44*	9.6
Deadlift	92.08 ± 11.94	102.50 ± 11.09*	11.3
GBR	23.67 ± 2.87	25.67 ± 2.36	8.4
GBL	19.83 ± 1.86	22.67 ± 1.60*	14.3

Iso MTP = Isometric Mid-Thigh Pull (KG) Deadlift =3RM Deadlift (KG), GBR = Single leg Glute bridge right, GBL = Single leg Glute bridge left. Mean ± SD and percentage change.

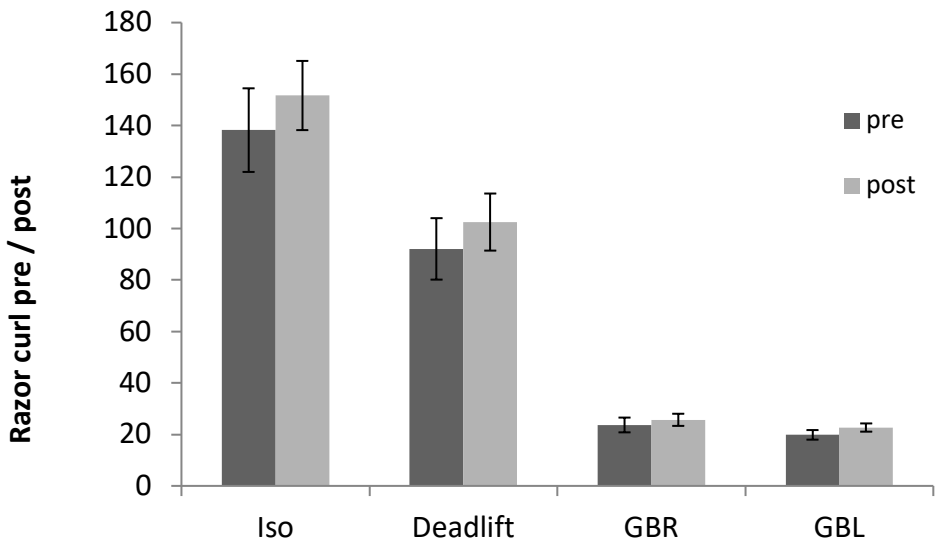

Figure 2: Razor Curl pre and post data represented as mean and standard deviation.

Table 3. Nordic Drop T-Stat and P-Value.

Exercise	***T-Stat***	***P-value***
Iso MTP	-3.8	0.01*
Deadlift	-2.2	0.08
GBR	-4.2	0.01*
GBL	-3.0	0.03*

Iso MTP = Isometric Mid-Thigh Pull (KG) Deadlift =3RM Deadlift (KG), GBR = Single leg Glute bridge right, GBL = Single leg Glute bridge left. In the Nordic drop group there was significant difference found in Iso mid-thigh Pull ($t = -3.76$, $p = < 0.01$), GBR ($t = -4.15$, $p = < 0.00$), GBL ($t = -2.98$, $p = < 0.03$). There was no significant difference found in the deadlift ($t = -2.24$, $p = > 0.07$).

Table 4. Razor Curl T-Stat and P-value.

Exercise	*T-Stat*	*P-value*
Iso MTP	-8	0.00*
Deadlift	-5.6	0.00*
GBR	-2.1	0.08
GBL	-3.0	0.03*

Iso MTP = Isometric Mid-Thigh Pull (KG) Deadlift =3RM Deadlift (KG), GBR = Single leg Glute bridge right, GBL = Single leg Glute bridge left. In the Razor curl group there was significant difference found in Isometric mid-thigh Pull (t = -8, p = < 0.00), Deadlift (t = -5.56, p = < 0.00), GBL (t = -3.00, p = < 0.03). There was no significant difference found in the GBR (t = -2.15, p = > 0.08).

Table 5. T-Stat and P-value for Post Nordic Drop vs Post Razor Curl.

Exercise	*T-Stat*	*P-Value*
Iso MTP	-1.29	0.22
Deadlift	-1.16	0.27
GBR	-1.13	0.29
GBL	-0.35	0.74

Iso MTP = Isometric Mid-Thigh Pull (KG) Deadlift =3RM Deadlift (KG), GBR = Single leg Glute bridge right, GBL = Single leg Glute bridge left. There was no significant difference between the two groups post intervention. Although increases of strength improved in all exercises in both groups there was no exercise that shows superior benefits.

Chapter Five

5.0 Discussion

The aim of this study was to analyse two hamstring exercises in a strength intervention programme and examine which possibly could have greater benefits in absolute strength, isometric strength and muscular endurance. The main findings show Nordic Drop and Razor Curl intervention seems to be an effective strategy for increasing lower limb strength in soccer players but both exercises show no significant differences when compared to each other post intervention.

Overall the result for the pre and post Nordic Drop group (eccentric) showed significant difference in Isometric Mid-Thigh Pull (IMTP), Single Leg Glute Bridge Right leg (GBR) and Single Leg Glute Bridge left leg (GBL). These results support earlier findings by Mjølsnes et al. (2004) who found Nordic Drops a very effective exercise for a training regime in developing maximal eccentric hamstring strength which may also be advantageous to prevent an injury occurring or also for rehabilitation if an injury has already occurred. Petersen et al. (2011) supports literature by Mjølsnes et al. (2004) finding adding additional eccentric hamstring exercise Nordic Drop decreased the rate of overall , new and recurrent acute hamstring injuries due to the strengthening of the musculature through the movement. The IMTP displayed significant change due to the strengthen nature of the Nordic Drop exercise on the posterior chain and Isometric strength increased. Muscular endurance GBR and GBL displayed the most improvements with GBR showing a 16.5% increase in strength pre and post intervention. This may be down to weakness in the right lower limb strength and with exposure to the Nordic Drop the hamstring musculature strengthened over the intervention. Arnason et al. (2004) have reported the nature of soccer that has asymmetric kinetic patterns is likely to have strength imbalances. This result was crucial to see as strength asymmetries have been linked to injuries to lower limbs in soccer (Tsepis et al. 2004). Nordic Drop exercise may be very important exercise to introduce in reducing these strength deficits. Deadlift did not show significant change. This may be due to the familiarity of the exercise as currently it is implemented in their in season programme also Deadlift may not have improved due to the hip movement needed in the movement and the Nordic Drop group were only exposed to an exercise that was knee

dominant as the Nordic Drop is performed with hip angle the same throughout the movement.

In the Razor curl group (concentric and eccentric) there was significant difference found in IMTP, Deadlift and GBL. The results displayed similar outcomes to previous findings by Bourne et al. (2017) who reported implementing exercises with a combination of hip and knee action are more effective for strength benefits when targeting all heads of the hamstring and the Razor Curl is an exercise that will try to strengthen the muscle in the concentric (shortening) phase and eccentric (lengthening) phase of a muscle contraction. The IMTP showed significant change due to the Razor Curl strengthening the posterior chain and attacking the hamstring proximally and at the distal end displaying an increase in isometric strength. The Deadlift showed the biggest percentage change producing an 11.3% increase in the Razor Curl group in comparison to the Nordic group 0.03 % increase. This finding could be due to the element of hip extension that the Razor Curl movement displays which is very similar to the deadlift exercise in terms of movement patterns of hip and knee needed to complete the exercise. The barbell deadlift displays high levels of activation in the Bicep Femoris just like the Razor curl (Andersen et al., 2018). The Razor Curl group displayed absolute strength increase. This finding is in conjuncture with Bourne et al. (2016) and Oakley et al. (2017) literature favours exercises that use hip and knee combination as they are more effective in reaching all parts of the hamstrings. The GBL and GBR showed increase in strength pre and post intervention but only a significant change in muscular strength in GBL. There was no significant difference found in the GBR although there was still strength increase with a percentage increase of 8.4%. The significant difference in the GBL could be due to a strength deficit in the left leg as Arnason et al. (2004) have reported the nature of soccer that has asymmetric kinetic patterns is likely to have strength imbalances. This result show Razor curl was effective tool in increasing muscular strength.

Pre intervention both groups were evenly matched from testing and were put into two groups of six for the intervention from scores from absolute strength 3RM deadlift score. When comparing Post intervention results of both Nordic Drop and Razor Curl groups no significant difference was found in IMTP, Deadlift, GBR or GBL. Although both groups increased absolute, isometric and muscular strength when results were compared no significant difference was found this suggests both groups had similar

strength increases and not one group had better results. The results of the percentage change in both groups all show a strength increase in each exercise as shown in Table 1. and Table 2. This indicates both Nordic Drop and Razor Curl has can be effective in a training intervention as each other for improving strength. Implementing strength programmes with hamstring strength exercise are key in preventing injury as demonstrated by Askling et al. (2003) ,Guex et al., (2016), Rey et al.(2017).

6.0 Conclusion

From the results of the study completed both Nordic Drop and Razor Curl have shown to increase Absolute, Isometric and Relative (muscular endurance) in a 6 week training intervention in soccer players. Furthermore strength increases were shown in all exercises but only ISMP, Deadlift, GBL showed significant difference in the Nordic Drop group Deadlift exercise showed no significant difference. Strength increases were shown in all exercises but only ISMP, Deadlift, GBL showed significant difference in the Razor group GBR exercise showed no significant difference. When implementing an exercise for hamstring strengthening both exercises are as effective for training regimes. Data collection took place at the start of the season due to accessibility, however recommendations for future research to see the best adaptations, preseason might be the optimum time to implement strength training intervention.

The IMTP, Deadlift, GBR and GBL were all reliable tests to measure hamstring strength in soccer players. All three tests required little time, resources and were time efficient. Furthermore these exercises can all be implemented in hamstring training programmes for strength gain and therefor potentially act as preventive strategy against injury.

Following on from the investigation there were a number of limitations that occurred when testing took place that could have impacted the results. Sample size was a limitation in this study small participation numbers. The number of participants that took part was 12 soccer players total six in each group. This sample size could only be accessed as some players could not take part in the study due to age restriction of the study was 18 years old or over. Another limitation was players were currently participating in other training regimes for strength increases upper and lower body

circuits twice a week. This could have had allowed some players to have strength increases due to the adaptations of their programme and affected the intervention results. Some players had previous experience with weightlifting movements but it was clear some players needed more exposure to the movements when testing was taking place as some individuals had issues with technique. Hamstring training can be part of any training protocol in most field sports. Literature prominently has Nordic Drop as a feature but perhaps more hip and knee dominant exercise can explored for implementation in strength training interventions. In order to improve accuracy and reliability of the study a larger sample is needed and other training regimes do not take place.

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Appendix 1

Consent Form for participants

Consent Form

I consent that I am above 18 years old and I am informed of the risks of participating in this study. I have no medical issues that have not been explained to the tutor. I am fully aware I can withdraw from the study at any stage. Any form of injury before or during the study will lead to a withdrawal. All information will be data stored and fully protected.

Signature of participant _____

Signature of tutor_____

Appendix 2

Consent form for methodology

Clearance Form

Approval has been granted for the methodology outlined by Tony Sullivan and clearance has now been given for the project to proceed.

Signed: (Advisor)

Student's signature

Date

Appendix 3

Programme

Nordic Drop		
Week 1-3	Week 4	Week 5-6
Monday & Friday	Monday & Friday	Monday & Friday
3 sets 6 repetitions	2 sets 6 repetitions	4 sets 6 repetitions
Rest 3 minutes between sets	Rest 3 minutes between sets	Rest 3 minutes between sets

Razor Curl		
Week 1-3	Week 4	Week 5-6
Monday & Friday	Monday & Friday	Monday & Friday
3 sets 6 repetitions	2 sets 6 repetitions	4 sets 6 repetitions
Rest 3 minutes between sets	Rest 3 minutes between sets	Rest 3 minutes between sets

Appendix 4

Protocols

Single leg Glute Bridge

- The test started with participants lying flat on the ground with right foot on 60 cm box and left foot vertical to avoid assistance to the leg doing the work.
- The participant completed as many repetitions to failure as possible on the Single leg Glute bridge right (GBR) before switching to test the Single leg Glute Bridge left leg (GBL).
- This showed any asymmetries in the participant's lower limb strength if they scored differently on each leg.
- Each participant started the procedure on the opposite leg to the previous participant after scores are recorded.

Isometric Mid-Thigh Pull

- The Mid-thigh pull test started with the participant standing upright on the base of the dynamometer.
- Distance from greater trochanter to lateral epicondyle was measured and halfway between the two points was where each participant initiated the pull.
- The participant was guided to put his feet in the correct position on the platform and instructed to let arms hang straight down to hold the bar with both hands with an overhand grip.
- The knees were bent at 110 degrees and the participant had their back forward and looking straight ahead.
- When the participant was positioned correctly they were instructed to pull hard as possible on the chain and straighten legs with arms straight.
- Each participant was given one attempt for familiarisation and one recorded attempt.

Deadlift (3RM)

- The three repetition max Deadlift was completed using the standards outlined by the NSCA.

- The participant was instructed to place feet under hips with hand placement on the bar outside of lower limbs.
- The participant was then instructed to lift the bar with braced core by extending the hips and knees until the body reached a full erect torso position.