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Examination of Lower Limb Ambidextrous Execution of the Snap Down Technique in Folk Style Wrestling

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Table of Contents

List of Appendices

List of Tables

List of Figures

Abstract

The purpose of this study was to examine the kinematic motions of the lower extremity in the snap down technique. Specifically, the study examined the kinematic differences between execution using the dominant and non-dominant side. Angular displacement, velocity and acceleration of the hip, knee and ankle joint was examined. It was hypothesized that a significant statistical difference would be observed in multiple variables between the dominant and non-dominant limb execution. Five male collegiate wrestlers were recruited for participation in the study. Inclusion into the study was on the basis that each participant was right side dominant and displayed proper foot placement when performing the technique. Each was instructed to perform a total of ten snaps, five using each side. A standard two-dimensional kinematic analysis was conducted using data obtained at the maximal point of head impact on the mat. The results showed a significant statistical difference only at ankle joint angular acceleration ($p = 0.02$), though these findings were not strong enough to conclude a true difference. This indicated that lower extremity ambidexterity was achieved by the college wrestlers in the study. Further studies and future research may be warranted to examine the kinematic differences of the technique on the basis of weight class and/or experience level.

The sport of wrestling dates back as far as recorded history. Folk style is a subdivision of that ancient sport, considered the most popular form of wrestling in U.S high schools and universities. An important skill in folk style wrestling is known as the snap down, a skill that allows the wrestler to takedown the opponent from a standing position effectively. However, there is a lack of scientific literature that examines the kinematic motions of the snap down technique bilaterally. Understanding athletic ambidexterity is an important factor in athletic performance and injury prevention, particularly in wrestling. Therefore, the purpose of this research study was to bilaterally examine the kinematic motions of the lower extremity in the snap down technique. Five male college wrestlers volunteered to participate in the study. Joint reflective markers were placed on both sides of lower extremity. The participants performed five snap downs with the dominant (right) arm and another five snap down with the non-dominant (left) arm against an opponent who was equipped with the wresting gear as well. A standard two-dimensional kinematics analysis was conducted with a camera set up to capture the sagittal view of the snap down motion. A paired sample *t*-test was conducted at $\alpha = 0.05$ to examine differences between the kinematics of right and left lower body joints. The results of the study revealed no statistical significant difference but showed that execution on the non-dominant side did not continuously accelerate through the point of impact, suggesting a lack of follow through on that side. Based on the results of the study, it can be concluded that ambidexterity is possible in college wrestling athletes.

Folk style wrestling is the most popular form of wrestling in United States' high schools and universities. It differs from other forms of wrestling because the focus is on control over opponents rather than developing explosive action ("The History", 2012).

Wrestlers are discouraged from throwing their opponents to avoid injuries ("The History", 2012). The length of each period differs, with the first period lasting three minutes while the second and third periods are only two minutes apiece. Riding time is also a concept unique to this style. It is a scoring system which awards an extra point to the wrestler who maintains top position for more than a minute ("The History", 2012).

An important skill in folk style wrestling is known as the snap down, a skill that allows the wrestler to takedown the opponent from a standing position effectively. It is a basic skill that every wrestler develops during the course of their training. The study of the snap down technique in folk style wrestling remains unaddressed. By studying the kinematic motions of the snap down technique, as well as the differences between its execution from dominant and non-dominant legs, coaches and athletes will have the opportunity to gain a comprehensive understanding of how the body moves and in what ways they can improve their execution. It is important to note that the center of gravity for humans is located within the pelvic region. Many of the largest and strongest muscle groups of the body are located within the lower half of the body (i.e., quadriceps group, hip flexor group, adductor group, hamstring group) (Moore, Dalley & Agur, 2014). In conjunction, center of gravity and muscle location offer the potential for greater power and force generation. Thus, a wrestler with the ability to effectively utilize these two factors will be able to improve technique effectiveness in matches and reduce the incidence of injury. By making athletes aware of the implications that proper joint angle, velocity and acceleration can have on human body structures, one can better instruct athletes on how to correct form through use of visual aids. Additionally, strength and conditioning coaches may utilize the information gathered from this study to prescribe a

better training program for their teams. Finally, due to the lack of literature on ambidexterity, understanding bilateral movements in sport skills will help advance the body of knowledge in the field of sports biomechanics. Therefore, the purpose of this study was to examine the kinematic motion of the lower body joints during the execution of the snap down technique between the dominant (right) and non-dominant (left) leg. The researcher hypothesized that the kinematic variables (angular displacement, velocity, and acceleration) of the dominant leg would be significantly different than that of the non-dominant leg.

Review of the Literature

The History of Wrestling

Wrestling is a sport of antiquity, popular throughout recorded history. Egyptian and Babylonian reliefs from 3000 BCE, records in India from 1500 BCE, Chinese documents from 700 BCE, and Japanese texts from the 1st century BCE all attest to its popularity (Augustyn, Chauhan, Cunningham, Lotha, Shepherd & Young, 2014). Ancient Greece was where wrestling became infamous though. It was well established by the first Olympic Games in 776 B.C (Augustyn et al., 2014). With the decline of Greek culture and rise of the Romans, wrestling was adopted by Romans but lacked the popularity and brutality it had with the Greeks. When the Roman Empire crumbled, references to the sport of wrestling all but vanished from European documents until around 800 CE (Augustyn et al., 2014). Wrestling made the voyage to the New World with the first American settlers from England. Colonists also found wrestling quite popular among the Native Americans. Only the catch-as-catch-can style survives from colonial times, and it has evolved into the modern form of collegiate wrestling (Augustyn et al., 2014). New York City held the first national wrestling tournament in 1888; Saint Louis became the site of the first wrestling competition in the modern Olympic Games in 1904. The first National Collegiate Athletic Association Wrestling Championships officially began in 1912 in Ames, Iowa ("The History", 2012).

Previous Research Studies on Wrestling and Martial Arts

Wrestling is a sport that has been largely overlooked by the research community. Research studies have been conducted on various forms of martial arts, but few have been conducted to examine skills in wrestling.

Jang, Chen, Chang, Fu and Lu (2009) conducted a study with a degree of relevance to the present research. The researchers intended to investigate lower limb kinematics and center of pressure (COP) movements in wrestlers of the Greco-Roman and free style disciplines during the tackle defense. The study involved 18 male collegiate wrestlers (10 Greco-Roman, 8 free style). The Greco-Roman group had an average height of 171.1 ± 8.0 cm, and mass of 73.9 ± 11.5 kg; the free style group had an average height of 169.0 ± 5.2 cm, and mass of 71.8 ± 11.4 kg. A 3-dimensional analysis was conducted as the wrestlers defended attacks from the front, left and right sides. Results of the study revealed that free style wrestlers had greater knee flexion and knee rotation, as well as greater anterior/posterior excursions of the COP than their Greco-Roman counterparts. The researchers believed that this was attributed to the training differences between the two disciplines of wrestling (Greco-Roman being an entirely upper body variation).

A study conducted by Hübner-WoŸniak, Kosmol, Glaz and Kusior (2006) examined the anaerobic performance of upper limb muscles in elite wrestlers and boxers. The study attempted to simulate effort expenditure intensity during a wrestling or boxing match. Eleven Greco-Roman style wrestlers and thirteen boxers participated in the study. The participants had a mean age of 24.5 ± 3.9 and 22.8 ± 2.1 years, mass of 84.4 ± 13.2 and 71.8 ± 15.1 kg, and experience level of 11.1 ± 4.2 and 8.5 ± 2.5 years, respectively. Each athlete performed two tests on the arm using an electrically-braked Angio ergometer. Test one was a maximal 30 s arm cranking following a 5-min warm-up. Resistance was proportionate to body mass at a ratio of 0.055 kg/kg. Test two was a series of eight 15 s intervals maximal effort cranking against the resistance of 0.04kg/kg body mass. Blood samples were taken 5, 7, 9, 11, 13 and 30 min after exercise to assess

peak lactate concentration. The results indicated that in both tests performed wrestlers displayed a higher relative peak power than boxers.

Other research studies have examined various skills in martial arts. Trial & Wu (2013) conducted a study examining the differences in the joint angular displacement, velocity and acceleration of the hip, knee and ankle joints between the double-collar tie and double underhook positions in Thai Boxing. Participants executed six continuous knee strikes with the dominant leg (right) in each of the two clinching positions for a total of twelve knee strikes. Joint reflective markers were placed on the right side at the following joint locations: base of the fifth metatarsal (toe), lateral malleolus of the fibula (ankle), lateral epicondyle of the femur (knee), greater trochanter (hip), greater tubercle (shoulder), lateral epicondyle of the humerus (elbow), styloid process of the radius (wrist), and on the chin and forehead. These were used to ensure accurate measurements during the data collection process. The results revealed a statistically significant difference in the hip angular displacement (103.2 ± 13.4º and 88.4 ± 12.4º ($p = 0.00$) for the double collar tie and double underhook, respectively). They also showed a difference in angular acceleration at the knee (5083 ± 4422 º/s^2 and 1981 ± 2707 º/s^2 ($p = 0.03$)) and ankle (631 ± 1371 º/s^2 and 2581 ± 2191 º/s^2 ($p = 0.02$)). The researchers concluded that the hip flexion angle was more acute in the double collar clinching position technique, making it preferable when striking a target lower than the striker's knee. It also revealed that the angular accelerations for the knee and ankle were similar in both positions but differed at the hip. From the results of the study by Trial and Wu (2013), the importance of the lower body mechanics in martial arts skills is clearly illustrated.

Ambidexterity

What is ambidexterity? According to the Merriam-Webster Online Dictionary it can be defined as "the quality or state of being ambidextrous"; when looking further, the definition of ambidextrous is "able to use both hands equally well/with equal ease" (Merriam-Webster, n.d). The importance of ambidexterity in wrestling should not be undervalued. Wrestlers should be taught how to perform all wrestling techniques from both sides; if an opponent is preventing a right-sided striker from launching a takedown maneuver, possessing the ability to execute that move on the opposite side can surprise the opponent and likely result in a win for the wrestler able to do so.

However, the question of how to perform the snap down skill properly is not well understood. There is a lack of scientific literature that examines the mechanics of wrestling skills in the field of sports biomechanics. Most literature has examined the sport of wrestling from a psychological perspective, such as the mental perception of wrestling (Leng, Kang, Lit, Suhaimi, and Umar, 2012), the efficacy of wrestlers' technique in relation to their body measurements and motor coordination (Cvetkovic, Maric & Marelic, 2005), and the effect of various coaching styles on wrestling performance (Polansky, 1999) but few from a biomechanical perspective.

Research studies have examined the mechanics of ambidexterity in sports such as rugby and soccer. Dorge, Andersen, Sorensen and Simonsen (2002) examined the mechanics and kinematic variables of instep soccer kicking between the dominant and non-dominant legs of seven skilled soccer players. Prior to testing, 30 skilled players were asked to kick a ball eight times with each leg. A Doppler radar gun was used to measure ball velocity. The research team then selected seven players with the most

constant ball velocity using both legs for participation in the study. Each participant was asked to perform three instep place kicks on a stationary ball at full speed, using both dominant and non-dominant legs. Testing randomization was utilized between trials. The authors found that the ball's velocity was higher with the dominant leg due to higher foot velocity from a smoother, more fluid motion during the kicking technique.

In a similar study Harrison and Mannering (2006) examined the kinematics of preferred and non-preferred instep kicking action in competitive soccer players. The purpose of their study was to examine the kinematic differences of the lower extremity when kicking a soccer ball using one foot or the other, as well as the kinematics of the hip/pelvis and the movement of the standing and kicking legs. Seven male intervarsity level soccer players, with a mean age of 19.9 ± 0.8 years, volunteered for the study. Each subject performed eight maximal instep kicks at a target, first with the non-preferred and then the preferred foot. The results revealed the following. The kicking leg knee angle was significantly larger in the preferred leg, implying greater leg extension at point of ball contact. In the non-preferred kicks lateral pelvic tilt angle was significantly smaller, indicating a greater pelvic tilt when kicking with the preferred leg. It was found that when kicking with their preferred foot subjects placed their standing foot closer to the ball, as well as approached the ball from a straighter direction. No significant statistical difference in standing leg knee angle between preferred and non-preferred leg. The researchers concluded that when kicking with the non-preferred leg the subject placed the standing foot farther away from the ball and had a smaller kicking knee angle to increase the kicking arc and create a longer contact time with the ball, thus allowing for greater control of ball direction and accuracy of the kick.

A study by Ball (2011) evaluated the drop punt kick in 17 professional male rugby players between the dominant/preferred and non-dominant/non-preferred legs. The authors found that hip range of motion, angular velocities of the knee, shank and foot were higher in the dominant leg, while hip and thigh angular velocity of the non-dominant leg were greater at the point of contact with the ball. The conclusion was that when using the dominant leg the participants utilized the knee, shank and foot to a greater degree whereas with the non-dominant leg the hip and thigh had greater emphasis.

In the area of combat sports Hsieh, Huang, and Huang (2012) conducted a study on the kinematic and kinetic differences of the roundhouse kick in taekwondo. The purpose of the study was to compare a 360^{o} turning roundhouse kick performed by both the dominant and non-dominant leg, and then find the correlation to impact velocity. Nine elite taekwondo athletes were recruited for participation in the study, with an average age of 22.3 ± 2.6 years, height of 173.6 ± 3.9 cm, and mass of 67.3 ± 6.8 kg. Each subject was instructed to perform the technique three times with each leg; the best trial of the three (based on subject balance, kick velocity, target position, and leg landing position) was then selected for analysis. The researchers measured the kinetic variables of center of mass difference among peak height and ready height, peak toe velocity, impact toe velocity, and peak ankle linear velocity; measured kinematic variables were peak back leg vertical force, peak front leg vertical force, front leg vertical impulse, and front leg horizontal impulse. Results revealed that from a kinetic standpoint peak toe velocity was greater in the dominant than non-dominant leg, as was peak ankle linear velocity. Kinematic results revealed that peak front leg vertical force reached a significant level, and that center of mass difference among peak height and ready height was greater in the

dominant leg's performance. It was concluded that in seven of the tested variables the dominant leg was significantly better than the non-dominant leg, illustrating that while both legs are expected to have similar demands and training an advantage still exists between the two.

When looking at all of the different studies there is an overarching theme present. It appears that ambidexterity is lacking in a number of different sports. This is readily apparent in technique execution and kinematic measurement of angular velocity and acceleration, particularly during the kicking of a soccer ball. This is important to note because it reveals that the under-emphasis on developing ambidexterity is not exclusive to wrestling. Ambidexterity is greatly undervalued during training, yet it can create possibilities for success during competition that would otherwise be unavailable (a right side dominant soccer player kicking and scoring a goal off of their left foot for example). The same holds true for wrestlers during execution of the snap down technique. Possessing the capability to snap down an opponent using either dominant or non-dominant side can mean the difference between success and failure during a match, especially if a performance-hindering injury is incurred on the dominant side. By providing statistical data to reveal potential deficits in bilateral technique execution, this study can be used to help develop training and strengthening programs to better address and correct the deficiency.

Previous Research Study of the Snap Down Technique

A previous study conducted by DeCastro and Wu (in press) examined the kinematic variables of the snap down technique, specifically the angular displacement, velocity and acceleration of the shoulder and elbow joints. Six amateur level wrestlers,

with a mean age of 21 ± 2 years, mass of 68.2 ± 13.6 kg, and height of 1.8 ± 0.1 m were recruited for participation in the study. Seven reflective joint markers were placed on the body at the shoulder, elbow, wrist, hip, knee, ankle and toe. Participants performed five trials on both sides, randomized between dominant (right) and non-dominant (left) sides.

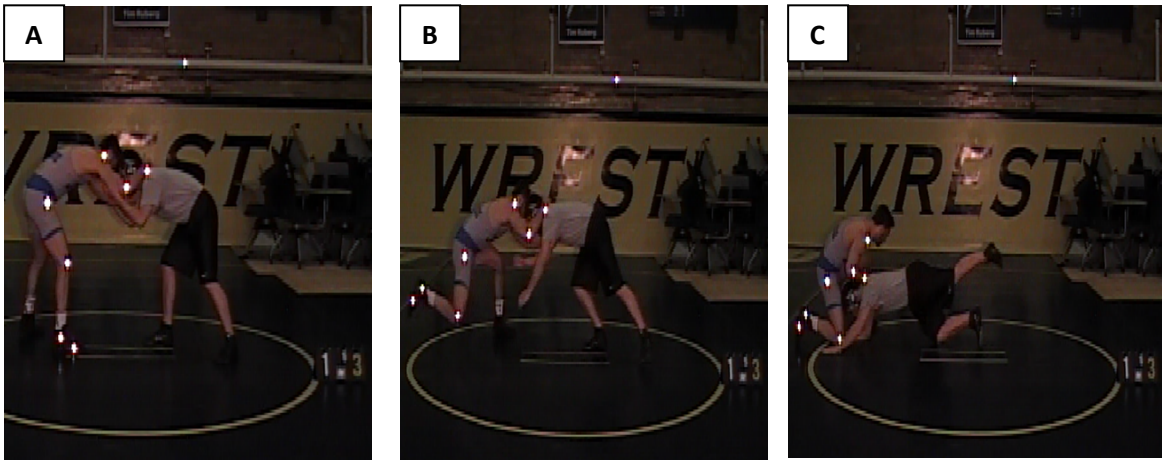

Figure 1: The progression of the snap down technique from the right side: A) start position, B) executing, and C) finish position.

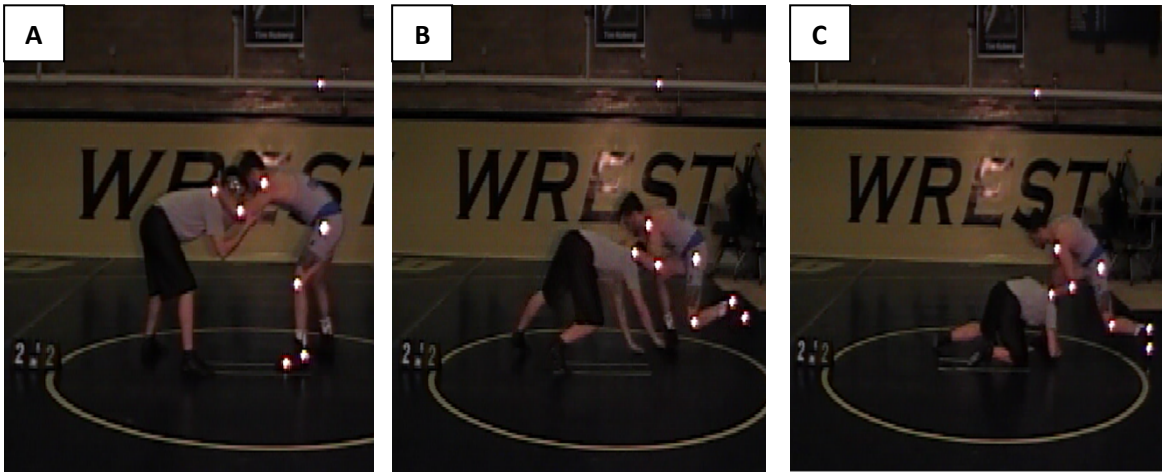

Figure 2: The progression of the snap down technique from the left side: A) start position, B) executing, and C) finish position.

The results revealed that angular displacement of the right and left elbows was 113.2 º ± 32.1 º and 123.2 º ± 30.6 º (p = 0.09) respectively; angular velocity was 178.7 º/s ± 203.4 º/s and 312.5 º/s ± 432.8 º/s (p = 0.57); angular acceleration was 951.3 º/s^2 ± 2377.6 º/s^2 and 927.5 º/s^2 ± 4188.8 º/s^2 (p = 0.99). Statistical comparison showed angular displacement of the right and left shoulders to be 38.8 º ± 17.6 º (p = 0.55); angular velocity was 36.4 º/s ± 70.1 º/s and 180.4 º/s ± 231.8 º/s (p = 0.16); angular acceleration was 915 º/s^2 ± 1020.5 º/s^2 and 269.8 º/s^2 ± 2514 º/s^2 (p = 0.58). The results showed no statistical difference between right and left sides in any of the tested parameters, which demonstrated that collegiate wrestlers were able to successfully execute the technique with equal effectiveness using the dominant and non-dominant side (achieved ambidexterity) in the upper extremity. The questions of ambidexterity for the lower extremity remain to be answered. Therefore, the results of this study may potentially help coaches and trainers obtain a comprehensive understanding about snap down technique in folk style wrestling.

Methods

Participants

Five male college wrestlers were asked to participate as volunteers in the study, with an average age of 21 ± 3 years, mass of 68 ± 12 kg, and height of 1.78 ± 0.13 m. Participants were free of injury and recruited from local universities at the Division 3 level. Each participant was a varsity member of their program and currently on the active roster. Additionally, all participants were right limb dominant to remove potential ambiguity regarding the question of limb dominance. Institutional research ethics review was obtained, as well as written informed consent from each participant prior to the study (Appendix A). Testing was conducted at the wrestling room of each respective university.

Protocols and Experimental Set Up

Each participant was instructed to warm up as they would normally before practice or competition. All participants arrived at the wrestling room in tight-fitting wrestling competition clothing. On both sides of the body reflective joint markers were placed over the wrestling shoe at the base of the 5th metatarsal, lateral malleolus, lateral aspect of the knee joint, greater trochanter, acromion process, lateral epicondyle, and the ulnar styloid process. Regulation headgear, wrestling shoes and mouth guards was used to simulate the movements in a real match and to ensure athlete safety. The participants were instructed to start in a standing neutral position and perform five snap downs with their dominant (right) arm and another five snap down with the non-dominant (left) arm against an opponent who was equipped with the wresting gear as well. The order of execution (right versus left side of the body) was randomized to reduce the order effect, and the same opponent was used for all five male wrestlers to ensure the consistency of

the data. Participants were given a one minute rest period between each snap down and a five minute rest between each arm.

Instrumentation and Statistical Analysis

A standard two-dimensional kinematic analysis was conducted with a camera set up to capture the sagittal view of the snap down motion. Trials were recorded using a JVC video camera (Model: GR-D371V, JVCKENWOOD Corporation, Japan) captured at 60 Hz in conjunction with a 650W artificial spot light. Kinematic motion of the hip, knee and ankle was analyzed (joint angular displacement, velocity and acceleration) at the point of head contact with the mat using the Ariel Performance Analysis System (APAS) software (version 2012). The digital filter function was applied to the data with the appropriate cut off frequency (X = 7Hz, Y = 7Hz). A paired sample *t*-test was conducted at $\alpha = 0.05$ to examine the kinematic disparities between the right and left lower extremity joints. All statistical analyses were conducted with Statistical Package for the Social Sciences (SPSS) software, (version 18, IBM Corporation, Endicott, New York).

Results

A paired sample *t*-test (n = 5) was conducted between the right and left side snap down execution. The angular displacement, velocity and acceleration of the hip, knee and ankle was analyzed using SPSS software ($p < 0.05$). The results are listed in the following tables (1, 2 and 3). Statistical comparison revealed that the only significant difference occurred between right and left ankle acceleration ($p = .02$). No other testing parameter showed a statistical significant difference.

Table 1. Statistical results for joint angular displacement in the lower extremity

Position	**Hip (°)**	**Knee (°)**	**Ankle (°)**
Right Side	79.7 ± 25.7	115.2 ± 19.4	112.0 ± 14.7
Left Side	73.2 ± 23.7	135.5 ± 35.7	123.3 ± 14.8
***p*-value**	.29	.40	.27

Note* Statistical significance $p < 0.05$

Table 2. Statistical results for joint angular velocity in the lower extremity

Position	**Hip (°/s)**	**Knee (°/s)**	**Ankle (°/s)**
Right Side	14.0 ± 65.1	32.8 ± 54.6	37.0 ± 54.6
Left Side	15.4 ± 58.0	58.0 ± 170.2	23.6 ± 68.1
***p*-value**	.97	.72	.77

Note* Statistical significance $p < 0.05$

Table 3. Statistical results for joint angular acceleration in the lower extremity

Position	**Hip (°/s^2)**	**Knee (°/s^2)**	**Ankle (°/s^2)**
Right Side	407.9 ± 386.5	482.1 ± 782.6	1186.9 ± 498.9
Left Side	-126.5 ± 921.4	-441.5 ± 799.4	-380.8 ± 568.2
***p*-value**	.09	.15	.02*

Note* Statistical significance $p < 0.05$

Discussion

Folk Style Wrestling as a sport has received very little attention from the research community, particularly in regards to biomechanical analysis. The purpose of this study was to examine the snap down technique, specifically the joint angular displacement, velocity and acceleration of the hip, knee and ankle as the wrestler executed the technique using the right and left sides. The results of the study revealed that the only statistical significant difference was found on the angular acceleration of the ankle. No statistical significant differences were found in other kinematic analysis parameters.

When examining the results of the study, despite a dearth of significant statistical difference, an important finding was observed on the angular velocity and acceleration between right and left side execution. On the right side, the wrestlers showed a positive angular velocity and positive angular acceleration in all three joints, indicating that the motion of the snap down was speeding up. Conversely, the wrestlers showed a positive angular velocity but a negative angular acceleration in all three joints (i.e. slowing down) on the left side. In this study a positive velocity value indicates that the lower body joint (hip, knee and ankle) is moving into extension. A positive acceleration value indicates that the body joint is increasing in speed. With that context and looking at the differences between the data of the dominant (right) and non-dominant (left) leg, it can be determined that when the subjects were executing the technique with their dominant (right) side they "carried through" the motion, continuing to accelerate (extend) the lower extremity as the opponent's head made contact with the mat. When executing the technique with their non-dominant (left) side the subjects began to slow down at the point of head impact, implying a lack of follow through with the technique on that side.

A possible explanation for this finding may be due to a strength deficit on the left side and a level of unfamiliarity with non-dominant (left side) execution of the snap down contributed to the difference. The researcher believes that because the subject is accustomed to using the right leg to help drive the opponent down when they switch to the left side, they have not trained left leg to perform in the same manner. Instead of maximally driving the opponent into the mat the left side appears to simply be moving enough to get the opponent down. This could imply that there is a need for muscle strength development of the left side for sport-specific motion to help increase angular acceleration and "carry the motion" through to the end point.

Scientific literature has yet to evaluate ambidexterity in wrestling, but previous literature has examined ambidexterity in other sports such as soccer, rugby and taekwondo (Ball, 2011; Dorge et al., 2002; Harrison & Mannering, 2006; Hsieh et al., 2012). Dorge et al. (2002) examined the instep soccer kick and the researchers found that there was a difference in ball velocity between dominant and non-dominant kicking leg because of a more coordinated kicking motion in the dominant leg, resulting in higher foot velocity at impact. Harrison and Mannering (2006), in their similar study on the instep soccer kick found a significant difference in kicking leg knee angle and lateral pelvic tilt angle, both of which were greater in the preferred kicking leg. In examining the differences between dominant/preferred and non-dominant/non-preferred limb execution of the drop punt kick in rugby. Ball (2011) found hip range of motion, angular velocities of the knee, shank and foot to be higher in the dominant leg, while hip and thigh angular velocity of the non-dominant leg were greater at the point of contact with the ball, implying that the knee, shank and foot played a greater role in dominant limb execution

while hip and thigh had a greater role in non-dominant limb execution. Hsieh et al. (2012) examined the taekwondo roundhouse kick between the dominant and non-dominant leg. The study found a significant statistical difference in a number of kinetic and kinematic variables. Yet a study examining a relatively basic technique in wrestling failed to yield any such results. The reason behind the disparity in results may be due to the nature of each sport. When examining the instep soccer kick, drop punt rugby kick, and roundhouse kick there is a common theme present, which is that the execution of the technique occurs predominantly in the lower extremity. That does not preclude the contribution from the upper extremity but it is marginal comparing to the lower extremity. Therefore, this type of motion can potentially make the move simpler to perform. Conversely, the sport of wrestling is a whole body sport, incorporating both the upper and lower extremity in nearly every aspect of performance. In the execution of the snap down technique, the shoulders of the upper extremity initiate the movement by rapidly pulling the opponent's head toward the ground, and then the legs of the lower extremity quickly extend backward. Because the technique involves coordination of both upper and lower extremities, it creates a greater degree of difficulty during technique execution. In that respect a significant difference may be harder to detect because a deficit in one extremity or one limb can potentially be compensated for in another.

Future studies are warranted to further examine similar sports skills and provide definitive answers. In a future study researchers can examine the force of the opponent's head being driven into the mat when the technique is performed using the dominant and non-dominant limbs. This could be accomplished through the use of a padded force plate in place at the point where the opponent's head will meet the ground and/or an

accelerometer attached to the opponent's head to measure the speed at which it is closing on the ground. A future study would also benefit from gathering strength measurements of the subjects (1 repetition maximums for the bicep curl, hip extension, triceps extension, etc.) and isometric testing to better understand the differences in technique between subjects.

There are several limitations in this study should be considered. The small sample size, five wrestlers, provides a preliminary understanding in this research study. A greater sample size would increase the power of the statistical analysis and increase the likelihood of detecting a significant difference in the lower extremity. In addition, the experience level of the participants varied greater than expected, ranging from 3 to 10 years. Due to the limited response to recruitment for the study, and further exclusion reduction in subject pool became an uncontrollable factor. Another rather difficult variable to account for was body size and composition. While the research study called for a weight range of approximately 50 lbs (wrestlers were between 125 and 175 lbs), participant body composition varied greatly within that aforementioned range. Arguably the largest limitation however is that this study was not conducted in a live scenario, but in a controlled setting. The results therefore will be less applicable to wrestlers during a real match. A future study designed to break down the execution of the snap down on the basis of weight class may be a viable option to examine what impact it may have on technique execution.

Conclusions

This study used five college wrestlers to examine the ambidexterity potential of the snap down technique. This study provides an understanding of the kinematic mechanics of the snap down technique in Folk Style wrestling when performed on the dominant (right) and non-dominant (left) sides of the lower body. The results showed a significant statistical difference only at the ankle joint when comparing angular acceleration between the dominant and non-dominant side. Therefore, this study concludes that collegiate level athletes have the ability to execute the snap down technique with near equal effectiveness using both their dominant and non-dominant side, therefore displaying ambidextrous capability. The study suggests that a strength and conditioning program can be prescribed with particularly emphasis on the left leg to assist in the performance improvement of the snap down technique on the left side. Future studies may be warranted to examine the potential differences in technique execution on the basis of experience level and/or weight class.

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Appendix A

Bridgewater State University Informed Consent Document

Title of Research: Kinematic Comparison of Dominant and Non-dominant Arm Execution of the Snap Down Technique in Folk Style Wrestling

Researchers: ***Dr. Tong-Ching Tom Wu, MAHPLS, (508) 531-2524***

Nicholas DeCastro, ATS, (774) 929-5231

You are being asked to participate in a project conducted through Bridgewater State University. The University requires that you give your signed agreement to participate in this project.

The investigators will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask them any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have.

If you then decide to participate in the project, please sign on the last page of this form in the presence of the person who explained the project to you. You should be given a copy of this form to keep.

Nature and Purpose of the Project

The Snap Down Technique is one of the most basic yet important moves taught to a wrestler. It allows the athlete to set their opponent into a potential pinning position, or at the very least forces them on the defensive in a match. The proper body position and motions when performing the technique are often unrefined however; this can lead to poor performance on the mat and even the possibility of injury. Therefore, the purpose of this study is to examine the movement coordination patterns of the wrestler's elbow, shoulder and hip, record the positions they are in during the technique, and the speed at which they move during the performing of the move. The results will provide an understanding of how each part of the body interacts with each other and how the movements can be refined, ultimately leading to a reduction in injury due to improper position, as well as a useful tool in instructing future athletes.

Explanation of the Procedures

You will arrive to the Biomechanics Laboratory in the Adrian Tinsley Center at Bridgewater State University. You will warm up with your regular warm up routine . After warm up, you will be instructed to perform a snap down on a testing model. You will do this 3 times, and will be given as much time as needed for rest between executions. This testing session will take you

approximately an hour in duration. Five joint markers will be placed on the right side of your body at the shoulder, hip, knee, ankle and toe. Two JVC video cameras will be used to capture the side and back views of the snap down motion at 60 frames/second, and your video trials will be analyzed.

Discomfort and Risks
The only potential risk of the study is due to fatigue. You are allowed to warm up and take breaks throughout the duration of the study whenever you feel is needed. Therefore, fatigue should not be an issue.

Benefits
The anticipated benefits include the analysis of your snap down technique. You will have a chance to know and understand the mechanics of your body motions better.

Confidentiality
All information will be stored in Dr. Wu's locked office and may be stored up to three years, after which it will be destroyed. Your confidentiality will be upheld to the extent permitted by law.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
* Representatives of Bridgewater State University, including the Institutional Review Board, a committee that oversees the research at BSU;

Refusal/Withdrawal
Refusal to participate in this study will have no effect on any future services you may be entitled to from the University or any other institution. Anyone who agrees to participate in this study is free to withdraw from the study at any time without penalty.

I understand also that it is not possible to identify all potential risks in an experimental procedure, and I believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

_____ _____

Participant Signature Date

_____ _____

Witness Signature Date

Any questions regarding the conduct of the project, questions pertaining to your rights as a research subject, or research related to injury, should be brought to the attention of the IRB Administrator at (508) 531-1242.

Any questions about the conduct of this research project should be brought to the attention of the principal investigator: ***Dr. Tong-Ching Tom Wu: (508)531-2524. Email: twu@bridgew.edu***