THE EFFECT OF DRIBBLING ON KNEE LOADING WHEN FEMALE BASKETBALL PLAYERS PERFORM SIDE STEP CUTTING MANEUVERS

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Knee injuries in females seem related to movements during sports specific, high risk activities such as cutting. Loading on knee when the players make side step cutting maneuvers has been considered to be a factor related to Anterior Cruciate Ligament (ACL) injuries. Our purpose was to examine differences in female players performing a side step cutting with and without dribbling. Using 10 elite female basketball players, three dimensional kinematic and kinetic data were assessed. Based on our investigation, elite female basketball players performing a side step cut with dribbling exhibited greater knee valgus angles and moments. Sport-specific neuromuscular training programs for basketball players could consider may adding ball control tasks.

KEY WORDS: Anterior cruciate ligament (ACL) injuries, dribbling, sport-specific.

INTRODUCTION:

Previous studies investigating ACL injury rates between male and female athletes have shown a 3-8 times greater incidence rate in females (Arendt & Dick, 1995; Malone et al, 1993; Messina et al, 1999). Deitch et al.,(2006) calculated the frequency of all injuries and the rate of game-related injuries between National Basketball Association (NBA) and Women's National Basketball Association (WNBA) during 1996-2002 seasons and reported that players in WNBA had four times greater ACL injury incidence rate than in NBA. ACL injuries frequently occur without contact, where the knee is in near full extension combined with knee valgus during running, cutting, and jumping tasks in soccer and basketball (Boden et al., 1996). Knee valgus angle and moment have been cited as primary factors in ACL loading and may be predictors of ACL injury (Markolf et al., 1995; Hewett et al., 2005). Markolf et al. (1995) reported from studies of cadaveric specimens that the ACL sustained greater loads between 0°-20° of knee flexion. Side step cutting maneuvers are very common offensive strategies used for evading defenders during sports such as basketball, soccer, football and team handball. Females have been found to perform cutting and landing tasks with less knee flexion (Malinzak et al., 2001) and greater knee valgus (Malinzak et al., 2001; McLean et al.,1999) when compared to males. Females also have been found to demonstrate greater external knee valgus moments than males when performing a stop jump task (Chappell et al., 2002) and in a preplanned side-step cutting task (Sigward and Powers, 2006). Recently, more sports specific and gamelike tasks have been investigated to better reflect a real game environment such as Mclean et al.'s, (2004) report where a simulated defensive opponent was utilized. They reported that female players had higher knee valgus angle during these more gamelike settings thereby posing the player to greater risk of injury. Furthermore, players that caught a ball or handled a lacrosse stick in other investigations have shown greater knee valgus loading during side step cutting (Chaudhari, et al., 2005). During a basketball game, it is unknown how differently players perform side step cutting when they are performing other tasks like dribbling. Therefore, our purpose was to investigate if the knee kinematics and kinetics would be different with and without dribbling.

METHOD:

Ten female basketball players from the Chinese Taipei university basketball association division 1 volunteered for this study. All participants were right-handed. A descriptive profile of the participants' characteristics is presented in Table 1. Participants were asked to perform repeated trials of two types of side step cutting maneuvers (dribbling and non-

dribbling). A fixed barrier was set behind the force platform to serve as a simulated defender (Mclean et al., 2004). We asked the participants to make contact with their left leg and pivot on the first force plate to make a 45 degrees side step cut from the original direction in order to evade the barrier. Prior to foot contact, the participants had a 3.5-4.5m/s approach speed. Approach speed was measured by two sets of photocells with a timer set in front of the force plate (one was 1m in front of the center of the force plate while the other was 4m in front of this). The overall length of the runway was 5m from the center of force plate.

Table1 Participants profile

Characteristic	Mean ±SD
Age(years)	21.4±2.32
Training experience(years)	9.7±2.16
Height(cm)	167.3±4.4
Mass(kg)	61±6.18

Table 2. The peak kinematics and kinetics of the knee between the two conditions (Non-dribbling/Dribbling) during the first 20% of stance phase.

	Non-dribbling	Dribbling
Peak Knee Angle (Degrees)	Mean±SD	Mean±SD
Flexion	35.4±7.9	38.4±7.7
Valgus*	-13.5±9.9	-17.5±9.4
Peak knee moment(N*m/kg*height)		
Flexion	1.87±0.61	2.38±1.17
Valgus*	0.36±0.24	0.78±0.37

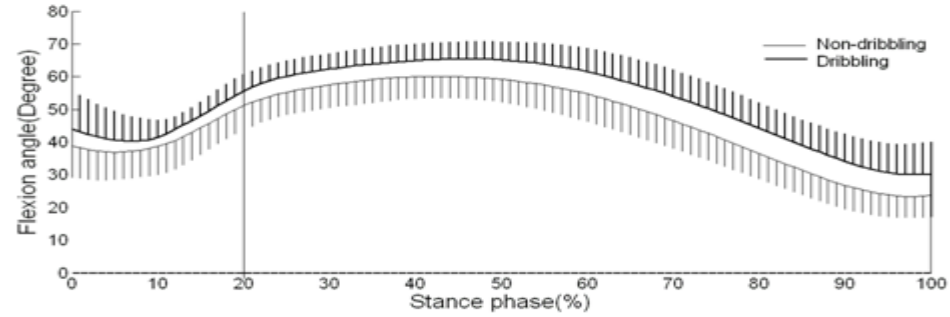
* Indicates significant difference between these two condition(P≦0.05)

Each participant performed the same maneuver three times with and without dribbling. Trials with and without the ball were performed at random. Vicon motion analysis system 10 cameras (200HZ) and a Kistler 9281 force plate (1000HZ) were used to collect the kinematics and kinetics data on each participant from each performance trial. The stance phase of the each trial was defined as when the vertical ground reaction force was greater than 10 N. Helen Hayes Marker placement, consisting of 16 retro reflective spherical markers (diameter: 16mm), was used to measure a static neutral and dynamic cutting trials. Vicon Nexus 1.2 software was used to quantify lower extremity motion and moments in the three dimensions. Marker trajectories were filtered by the procedure described by Woltring (1994). All kinematic and kinetic data were normalized to 100% of the stance phase. Boden et al. (2000) reported that the early deceleration phase of the stance phase (first 20%) may be where the majority of non-contact ACL injuries tend to occur. A dependent t-test was used to examine the differences on knee loading of the first 20% of stance phase between the two maneuvers. Statistical analyses were performed using SPSS 12.0 software. Significant levels where set at $P<=0.05$.

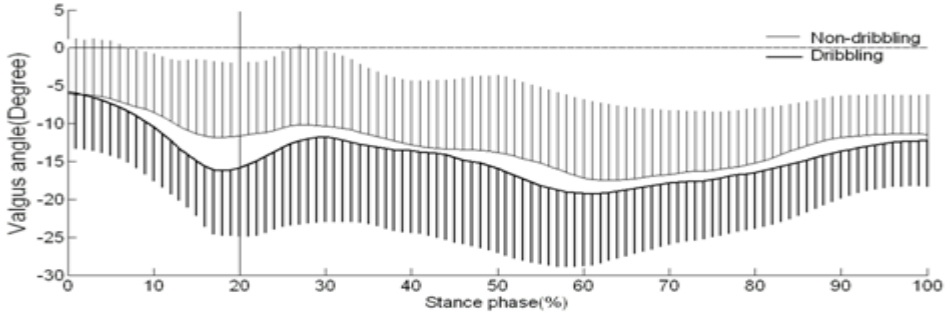
RESULTS and DISCUSSION:

The findings in our study presented on the Table 2 and Figure 1 and 2. The greater valgus angles and valgus moments were observed during the first 20% of stance phase while dribbling. Our observation suggests that the increased valgus angle and moment may be a risk factor during side step cutting for ACL injury. Increased knee valgus angle is documented to increase ACL loading (Markolf et al., 1995) and has been cited as a key mechanism of non-contact ACL injury (Besier et al., 2001; Mclean et al., 2005). Previous studies have shown that higher valgus moments place the ACL in greater danger (Woo et al., 1999, Hewett et al., 2005). The greater valgus angles and loading on knee during sport movement suggests an inability of the athlete's musculature to control the GRF (Ford et al., 2003). As a result, ligaments may be required to absorb the additional force to control motion contributing to ACL injury. Injury prevention programs seem to have some benefit (Hewett et al., 2005; Myer et al., 2005). Cowley et al., (2006) suggested that a sport-specific

neuromuscular training program based on which sport the athlete is participating in may be necessary. Hence, development of a basketball-specific neuromuscular training program may help female basketball players lower the risk of ACL injury.



(a)



(b)

FigURE 1: Comparison of knee joint kinematics between Non-dribbling and Dribbling in (a) sagittal, and (b) frontal during side step cutting. Error bars equal 1 standard deviation

CONCLUSION:

Based on our investigation, elite female basketball players performing side step cutting with dribbling exhibited greater knee valgus angles and moments. Sport-specific neuromuscular training for basketball players should consider adding a ball control task. Further work should consider evaluating hip motion and muscle activation levels of lower extremity during side step cutting with and without dribbling.

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V. Equipment and Instrumentation