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BETTER POSTURAL CONTROL DURING ACCURATE SHOOTING IN ELITE FEMALE BASKETBALL PLAYERS

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The purpose of this study was to evaluate the differences of postural control (PC) during accurate and inaccurate shooting in elite female basketball players. 21 female professional basketball players recruited as subjects. The PC was evaluated by the Accusway as sway radius, velocity, radial and 95% area of the center of pressure (COP) during standard penalty line shooting. The results showed that the COP sway area during accurate shooting was significantly smaller than during inaccurate shooting (74.0 ± 37.9 vs. 110.6 ± 49.1, $p < .05$). Moreover, no significant differences were found between situations in the COP radius and velocity. This study found that during the accurate shooting, elite female basketball player had better PC which demonstrated that significant smaller COP sway area than inaccurate shooting.

KEY WORDS: balance control, center of pressure, sway area.

INTRODUCTION: Basketball is a popular sport worldwide with high-intensity and aggressive body contact game of an intermittent nature. In order to win the game, players have to compete against opponents and shoot the ball into the basket as many as possible. It is estimated that two major ways to win the scores were one-handed jump shot scoring (approximately 60 %) and standing shooting (approximately 30 %). Therefore, a variety of exercise skills and tactical strategies training programs were being implemented in an attempt to increase shooting performance for elite basketball players. Postural control (PC) has an important role in injury prevention and in athletic performance. PC is preserved through the dynamic integration of internal and external forces and environmental factors. Each sport requires different levels of PC implying that different sensorimotor processes were adopted to perform exercise skills and protect the neuromuscular system from injury.
The skill requirements and competition demands of each sports were totally diverse and possessed different challenges to the sensorimotor PC than cumulatively influence the balance abilities of trained athletes. Take Gymnasts for example, they often perform leaping and tumbling skills in static position as well as barefoot on the ground, therefore, many of their skills require great strength and maximum joint ROM. Furthermore, Soccer players often perform lower extremity passing, dribbling, and shooting skills on variable turf conditions, therefore, many of their skills require great speed and better mobility. (Orchard, 2002). In contrast, basketball players often perform upper extremity passing, cutting, and shooting skills while wearing shoes on flat, stiff surfaces, therefore, the requirements of exercise skills and PC might be unique and not alike these aforementioned sports. It is believed that well PC during basketball shooting is very important, but to our knowledge, none of any studies comparing PC among accurate and inaccurate shooting in basketball players. Therefore, the purpose of this study was to compare the differences of PC during the accurate and inaccurate shooting in collegiate basketball athletes.

METHODS: Twenty collegiate level I basketball athletes (Age: 21.2 ± 4.0 yr, Ht: 173.3 ± 2.7 cm, Wt: 66.8 ± 6.2 kg; Training experience: 8.3 ± 2.7 yrs), without lower limb injury and right dominant limb, volunteered as participants. All participants received professional basketball

training more than five years with well competition experience from different school teams. To be included in the study, participants had to be currently competing in basketball sport for the previous 3 years and not be involved in a balance training program outside their typical sport training. Participants were excluded if they had a lower extremity injury, vestibular problems (eg, vertigo), visual problems (eg, blind in one eye), or a concussion with in the previous 12 weeks before the study. Participants signed an informed consent document approved by the university ethics committee (which also approved the study) and were asked to refrain from any exercise for 2 hours before testing.
PC was evaluated by using the AMTI AccuSway force plate interfaced with SwayWin software (AMTI, Inc, Watertown, MA, USA). Three-dimensional ground reaction forces were measured at a sampling frequency of 100 Hz. Center of pressure (COP) excursion radius, velocities, and areas were calculated by the SwayWin software. All subjects reported to the laboratory the first day to read and sign an informed consent form and to complete a self-report questionnaire designed to identify subjects' injuries. One week later, subjects returned to the laboratory for the shooting PC measurements.
During the shooting PC measure, participant was asked to stand on the forceplate with a standard basketball. When "go" signal was given, participant have to aim the basket frame (target) and shooting into the frame as accurate as possible (Figure 1). All the tasks were repeated 3 times and the average of the 3 trials was recorded. In the event that a subject experienced a loss of balance requiring them to step-off the plate, the trial was discarded and repeated.

Figure 1: Experimental setting for shooting test.

Data were expressed as Mean ± SD. Statistical analyses were conducted using SPSS for Windows 12.0 (SPSS Inc, Chicago, USA). The dependent *t* test was used to compare the difference of each PS parameter between accurate and inaccurate shooting. Statistical significance was set at α=0.05 level.

RESULTS: The Mean ± SD for each PC parameter was listed in Table 1. The COP lateral (X) and frontal (Y) sway ranges during the accurate and inaccurate shooting were 5.57 ± 1.94 cm and 13.75 ± 3.01cm versus 6.46 ± 2.41 cm and 13.45 ± 3.45 (p > .05). The mean radius (RDA) and sway path (Path) during the accurate and inaccurate shooting were 3.23 ± 0.75 cm and 37.68 ± 8.00 cm versus 3.63 ± 1.05 cm and 39.04 ± 8.51 cm (p > .05). The mean sway velocities (Vavg) during the accurate and inaccurate shooting were 7.54 ± 1.6 cm/sec and 7.81 ± 1.70 cm/sec (p > .05). However, accurate shooting had significant smaller COP sway area than inaccurate shooting (Area, 73.96 ± 37.87 vs. 110.6 ± 49.05, p < .05).

Table 1
The performance of PC during accurate and inaccurate shooting

	Accurate	Inaccurate	P Value
X(cm)	5.57 ± 1.94	6.46 ± 2.41	.32
Y(cm)	13.75 ± 3.01	13.45 ± 3.45	.82
RDA(cm)	3.23 ± 0.75	3.63 ± 1.05	.29
Path(cm)	37.68 ± 8	39.04 ± 8.51	.68
Vavg(cm/sec)	7.54 ± 1.6	7.81 ± 1.70	.68
Area(cm/sq)	73.96 ± 37.87	110.6 ± 49.05	.04

DISCUSSION: Standing posture is a complex system which concerns the maintenance of the relative positions of body segments. The use of numerous muscles and the integration of different sensorial inputs (visual, vestibular, proprioceptive) is a part of the complexity of this system. This study demonstrated that accurate shooting have significant smaller COP sway area than inaccurate shooting, implying that basketball athletes had significantly better proprioception function, well visual feedback and neuromuscular control of balance during the accurate shooting condition (Asseman et al., 2004; Verhagen et al., 2005).
Traditionally, PC has been considered an automatic response to vestibular, visual, and proprioceptive information. The greater changes observed in this study may be attributed to the variation during basketball shooting while maintaining balance which smaller COP sway during the accurate shooting than inaccurate shooting condition. It is found that the magnitude of postural sway variability can be affected by stance, segmental movements and visual feedback (Brooke-Wavell, Perrett, Howarth, Haslam, 2002). Moreover, the COP displacement has been observed to be approximately two-fold higher during tandem stance when compared to a normal bipedal stance (Vaillancourt & Newell, 2002).
This increase in magnitude of variability has been viewed as an increase in the size of the equilibrium region, where postural corrections are only made following higher amplitude excursions of the COP (Collins & De Luca, 1993). Posture during quiet standing (a static task) is controlled by sensory feedback using a closed-loop (feedback) system dependent on visual and proprioceptive information. By considering the body as relatively rigid across conditions, the Area and the Vavg of the COP appears to be a satisfactory parameters to evaluate the subjects' PC. The Area is correlated to centre of gravity (CG) one, and is an indicator of the subject's balance performance. The Vavg is an indicator of the muscular force variations and by extension allows evaluating the postural control (Asseman et al., 2004). Therefore, significant difference in Area but not in Vavg between accurate shooting and inaccurate shooting, represented better PC with similar muscular execution during the accurate shooting in basketball players.

CONCLUSION: This study demonstrated that accurate shooting have significant better PC performance than inaccurate shooting in female basketball players, especially smaller COP 95% sway area. Improved segmental proprioception function and well neuromuscular control during the accurate shooting might be the main reasons.

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