Quantified movement test of core muscles for Athletes

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The purpose of this study was to compare the different of the core muscles ability between normal subjects and athletes of an assessment consisted of seven movement tests. Nineteen participants were voluntarily recruited in this study and divided into normal subjects (N=9, age=20.2±0.7 y/o, weight:63.7±11.7 kg, height:170.9±6.7 cm) and collegiate athletes (N=10, age=19.9±1.0 y/o, weight: 72.4±7.8 kg, height: 172.5±4.5 cm). The result shows that the path length of plank, bird dog with right-hand raise, bird dog with left-hand raise, right side plank, right bridge, left bridge and area of right bridge, left bridge has significant differences between two groups (Table 1). Athletes exhibit shorter path length and smaller path area in all of these data.

KEY WORDS: core assessment, center of pressure, plank, bird dog exercise

INTRODUCTION: Core muscles are important to muscle group of our body, previous study proved that when we starting a movement, the rectus abdominis is the first activated muscle, then multifidus (Hodges, 1997). Scholars adopted this theory and try to confirm that the core stability is an effective factor of low back pain and knee injury, this thought has been proved in most researches. Clinically, how to measure the core stability conveniently and effectively becomes a concerned topic. Many scholars also described variety assessment methods of core muscle strength and muscle endurance (Akuthota, 2004). Otherwise, the neuromuscular control of core muscle was assessed by pressure biofeedback (Lima et al., 2012). However, assessment methods of core muscle strength and muscle endurance cannot represent the neuromuscular control of core muscles (Cowley& Swensen, 2008). And the reliability of pressure biofeedback is poor (Lima et al., 2012). Therefore, to development a reliable assessment method for test the neuromuscular control of core muscles is important. The purpose of this study was to determine the neuromuscular control of core muscles between normal subjects and collegiate athletes in 7 core muscles movements by a force platform.

METHODS: Nineteen male participants were voluntarily recruited in this study and divided into normal subjects (N=9, age=20.2±0.7 y/o, weight:63.7±11.7 kg, height:170.9±6.7 cm) and collegiate athletes (N=10, age=19.9±1.0 y/o, weight: 72.4±7.8 kg, height: 172.5±4.5 cm). All of these subjects study in university now, if they undergo an operation in last 3 months or they have the cardiopulmonary disease, low back pain, and difficulty to accomplish those core test

movements would be exclude. Collegiate athletes should meet the criteria that have accepted formal training more than five years, and sustained training for three times every week. Before the core muscles assessment, examiner explained the process for subjects then told the right and risk under the test. Each participant signed the informed consent. The study procedures have proved by the local medical university. The Zebris force plate system (WinFDM-T, zebris Medical GmbH, Germany) was used to collect the data of body sway path length of central of pressure (COP) when the subjects performed the seven core muscle movements on the unstable surface. The body sway path length of COP was used to represent the neuromuscular control of core muscles (Figure 1). The seven core muscle movements assessment were selected by previous studies (Atkins et al., 2015) (Guo et al., 2012), and consisted of plank, bird dog with right hand raise, bird dog with left hand raise, Left side plank, Right side plank, bridge with right leg extension and bridge with left leg extension (Figure 2). Every movement maintained on the force platform for 10 seconds, the sampling rates set up at 100Hz. The independent T-test was used to analyze the difference between normal and athletes subjects and the one-way ANOVA was used to analyze the difference among seven core muscle movements assessment in athletes and normal subjects.

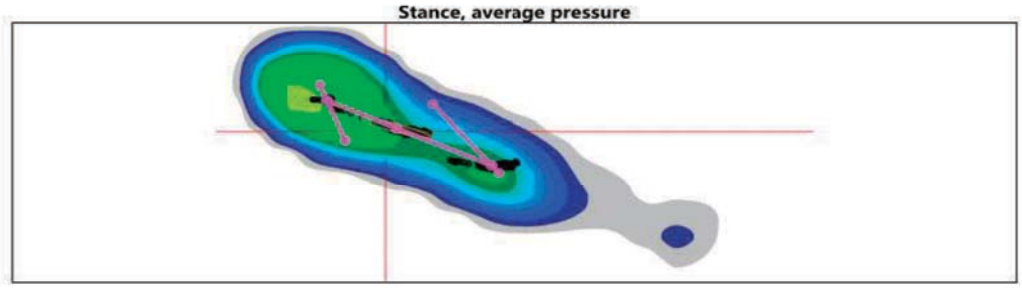

Figure 1. Path length of center of pressure

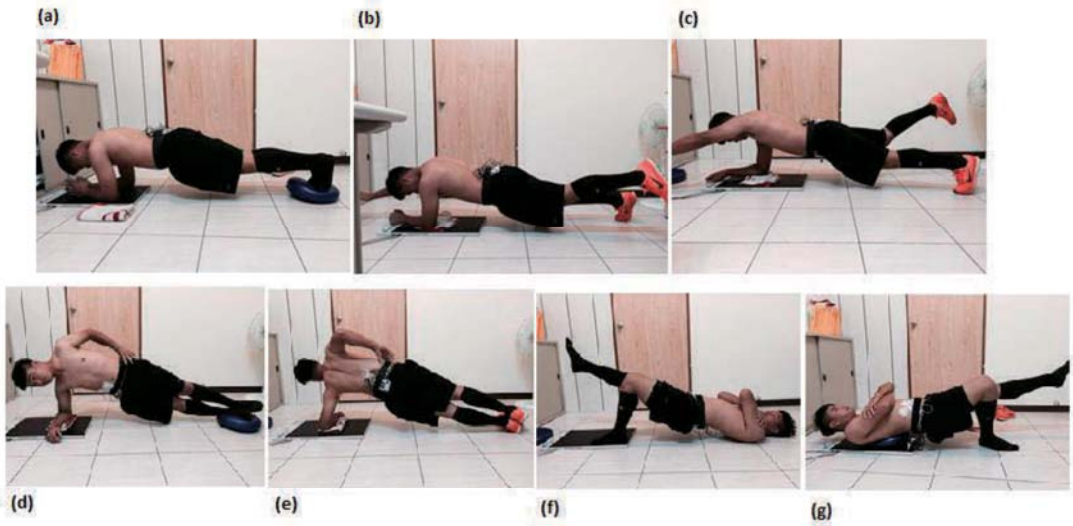

Figure 2. Seven movements of core muscles test. (a)Plank (b)Bird dog with right-hand raise (c) Bird dog with left-hand raise (d)Right side plank (e)Left side plank (f)Bridge with right

leg raise (f) Bridge with left leg raise

RESULTS: The result of independent T-test shows that the path length of plank, bird dog with left-hand raise, right side plank, right bridge, left bridge has significant differences between two groups (Table 1). Descriptive statistics proved that athletes exhibit shorter path length then normal group on every movement. One-way ANOVA shows that both of collegiate athletes and a normal group have difficulty difference existed on these 7 movements, but two groups have a different tendency. Collegiate athlete has the greatest path length of bird dog, then followed by bridge, side plank and plank are most stable movements. In normal group, the bridge is the most unstable movements, then bird dog, plank, and side plank are most stable movements.

Table 1.
Average and p value of path length of COP

	Average of athlete	Average of Normal	p value
P_PL	47.36±27.95	238.80±75.09	<0.001*
BDR_PL	418.38±158.31	828.91±574.46	0.068
BDL_PL	336.59±132.20	673.98±401.63	0.038*
RP_PL	190.78±94.27	360.03±84.07	0.001*
LP_PL	265.34±174.35	354.44±75.96	0.165
RB_PL	61.03±24.06	868±347.50	<0.001*
LB_PL	67.96±25.08	756.72±246.71	<0.001*

* = p <.05 means significnat difference, PL=Path length, P=Plank, BDR=Bird dog with right hand raise, BDL=Bird dog with left hand raise, RP=Right plank, LP=Left plank, RB=Bridge with right leg raise, L bridge=Bridge with left leg raise

DISCUSSION: The path length clarify the sway condition when subjects executed core muscles movements, according to previously research, we have already known that the deficiencies of center of pressure (COP) caused by poor static balance and usually can be considered a predictor of sports injury (Clifton, 2013). Athletes have better performance in every movement, it means smaller sway of the path length of COP, this fact confirmed that athletes have greater control of their core muscles. The previous study mentioned that core muscles strength and stability will influence trunk balance exactly (Carpes, 2008). Consider that the force platform used to measure core stability is a rare method, there should be another device to being a control group, which regularly uses on clinically, like ultrasound, biofeedback or electromyography, it's the missing of this experiment.

CONCLUSION:

These results suggest that except left plank, other movements exist significant different

between normal group and athletes. This assessment has been proved it can discriminate the core stability performance of athletes, afterward, we want to make this assessment become a reliable and validity system. If this assessment has been established will be convenient for sport medical personnel because the force platform assessment take less time to set up and easier to interpretation, it also have better flexibility that medical personnel easily portable, so we will try to recruit more subjects and build a norm scale

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