STEP EXERCISE OR VERBAL AND VISUAL EXERCISE AFFECT COG, KINEMATICS AND PERFORMANCE DURING DECELERATION: RANDOMIZED CONTROLLED TRIAL

Tomoyo Nishiura[1], Akino Aoki[1] and Kazuyoshi Gamada[1]
Hiroshima International University, Higashihiroshima City, Hiroshima, Japan [1]

The purpose of this study is that investigate if step skill exercise or verbal and Visual exercise affect the height of center of gravity (COG), kinematics and paformance during deceleration. Sample size are 24 people (step skill exercise, n= 12; Verbal and visual exercise,n=12) . In the result, step skill exercise increased knee joint flexion angles in stop and deceleration. Furthermore step skill exercise decreased the height of COG only deceleration. However step skill exercise increased performance time (reaction time) and had a negative impact.

KEY WORDS: ACL, exercise, kinematics, deceleration.

INTRODUCTION: The non-contact anterior cruciate ligament (ACL) injury is one of the most injuries in sports injury. It is estimated that approximately 250,000 ACL injuries occur every year in the United States (Griffin LY 2006). It changes normal knee to instability knee and makes it difficult to return the competition. In addition, ACL reconstruction costs vast medical expenses and needs long-term rehabilitation (Griffin LY 2000). Thus, it is an important thing to prevent the ACL injury.

ACL injuries occur when the athlete deceleration suddenly such as during cutting, turn and landing maneuvers (Boden BP 2000). However, there is not clear that COG, kinematics and performance during deceleration maneuver. Recentry ACL injury preventive program is studied. It is reported that less hip and knee joint flexion angle increase ACL injury risk (Blackburn JT 2008, Griffin LY 2000). Hewett et al (2005) reported that less knee joint flexion angle increase ACL strain in particular. Benjaminse et al (2015) reported that verbal and visual exercise increased knee joint flexion moment on female athlete. However, it has the better knee joint flexion angle and moment, the worse technique. The purpose of this study is investigating if step skill exercise or verbal and visual exercise affect the height of center of gravity (COG), kinematics and performance during deceleration. We hypotheses that ①knee joint flexion angle increases in both exercise,②more effective for knee joint flexion angles and performance only step skill exercise.

METHODS: After obtaining parent or guardian consent and athlete assent with Hiroshima International University of institutional review board approval. It was randomized Step skill exercise group (n=12) and verbal and visual exercise group (n=12). The protocol was performed for 10-minutes each interventions after baseline measurement. Then it was repeated same measurement after each intervention. Task was stop and back run at sign of

light. In step skill exercise, it was instructed that small step at stop back maneuver. In verbal and visual exercise, it was instructed that the deeper knee joint flexion, do not make sound and as possible as fast at stop back maneuver. This study has outcome that hip joint flexion angle (°), knee joint flexion angle (°), ankle planter flexion angle (°), trunk tilt angle (°), lower leg tilt angle (°), knee position (m), height of COG (m) and reaction time (s). It was measured with some reflection markers and two video cameras. It was analyzed with Wilcoxon signed-rank test in within group and with MannWhitney U test in between group by SPSS analysis software. The statistical significant difference is α=0.05.

RESULTS: In within group, it increased significantly knee joint flexion angle at two steps back with step skill exercise. And it decreased significantly height of the COG. However, it significantly increased ankle planter flexion angle (Table 1). It significantly increased hip joint flexion angle and knee joint flexion angle at IC with step skill exercise. However, it significantly took late reaction time (Table 2). There was no significant difference at verbal and visual exercise in two steps back. It significantly increased knee joint flexion angle at IC with verbal and visual exercise. In between groups, it took significantly late only reaction time of verbal and visual exercise compared with step skill exercise before intervention. It took significantly low height COG at two steps back with step skill exercise compare with verbal and visual exercise after intervention (p=0.017).

Table 1

Step Exercise – 2 Step Back

	pre		post		
	Mean	SD	Mean	SD	p-value
hip flexion (°)	32.64	10.45	38.85	11.60	0.099
knee flexion (°)	21.21	6.73	29.51	11.82	0.015 *
ankle plantar flexion (°)	28.06	13.70	39.77	14.33	0.012 *
trunk tilt (°)	98.31	10.84	98.90	8.83	0.308
lower leg tilt (°)	109.75	3.48	108.30	7.06	0.209
knee position (m)	0.32	0.02	0.33	0.02	0.670
OCG height (m)	0.49	0.03	0.46	0.03	0.003 **

Table 2

Step Exercise - IC

	pre		post		
	Mean	SD	Mean	SD	p-value
hip flexion (°)	36.25	10.03	44.31	10.43	0.015 *
knee flexion (°)	15.49	7.35	24.61	9.97	0.006 **
ankle plantar flexion (°)	54.17	19.33	55.78	15.70	0.754
trunk tilt (°)	105.52	9.01	101.31	8.59	0.060
lower leg tilt (°)	142.57	6.18	145.65	13.47	0.041 *
knee position (m)	0.32	0.02	0.31	0.02	0.855
OCG height (m)	0.40	0.02	0.40	0.02	0.713
time (s)	2.44	0.44	3.11	0.78	0.012 *

DISCUSSION: In precedent study, less knee joint flexion angle made ACL strains increase and increased ACL injury risk (Hewett TE 2005, Withrow TJ 2006). Particularly it made ACL injury risk increase at less knee joint flexion 30 degrees (Beynnon BD 1995). In this study, it made knee joint flexion angle significantly increase in both exercise. Furthermore it made knee flexion angle increase during deceleration with step skill exercise. It may reduce load to ACL for small step. However, we did not measure of the floor reaction. SO it is not clear in this study.

When ACL damage risks increase when the high center of gravity rises, I report height and the human trunk slant of the center of gravity in the precedent study (Blackburn JT 2009). In addition, in the study that I made the video analysis of the ACL damage player, it was proved that injured human trunk retroversion increased (Boden BP 2000). A center of gravity during slowdown movement at the time of the step technology training was significantLY low, but, in this study, the significant difference was not seen about a center of gravity and the human trunk slant in the IC either. Because stop movement knee joint flexure angles significantly increased during slowdown movement by the step technology training that the drop of a center of gravity during slowdown movement was seen in, it may be related to the height of slowdown movement centers of gravity and the knee joint flexure angle at the time of the stop. In reaction time, it made hip and knee joint flexion angle significantly increase in step skill exercise and height of COG significantly decrease. But it made reaction time significantly increase. In this study, intervention time was only ten minutes. It may need period for 4~8 weeks. We should beconsider intervention time and period. And we should be fine improvement methods to satisfy the conditions both of performance and kinematics.

CONCLUSION: In this study, we investigated if step skill exercise or verbal and visual exercise affect the height of center of gravity (COG), kinematics and performance during

deceleration. Step skill exercise made knee joint flexure angles increase in both stop and deceleration. Furthermore, it made height of COG decrease. However, it took performance to bad.

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