DYNAMIC STABILITY STRATEGY FOR ELITE JUDOISTS IN BALANCE CONTROL FOR ANTERIOR AND POSTERIOR PERTURBATIONS

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INTRODUCTION

Balance control abilities are essential for top athletes to reach optimal performance in competitions, especially for judoists [1]. Judo can be divided into attack and defence abilities, both of which influence winning. For response to attack, control of proper distance and force application to destabilize the rival through movement derives from control in balance. Stability of the centre of body weight must be maintained through intersegmental controlling. In order to avoid being attacked and falling, training for balance control of the body is important to the judo player[2]. Several studies have shown that judoists represent high balance performance, as measured from the through size of the COP area or scores on a balance system [2] with unstable platform perturbation. However, quantitative principles of balance strategy for judoists are still unknown, especially with waist perturbation similar to that in judo throwing. Therefore, this study investigated responses in terms of balance performance (using COP) and balance responses as measured using reaction forces to direction-dependent perturbation without anticipation. Postural control in two directions (forward, backward) for different skill levels of judoists was measured using force plates. These results may provide valuable information for selecting and training judoists scientifically.

METHODS

Experimental data were collected from fourteen elite-level judoists (Top twelve national level, Age: 21.2±1.9 years), fourteen subelite-level judoists (regional level from university teams, Age: 21.0±1. years), and fourteen non-judoist college students (Age: 21±2 years) performing perturbation balance control tests. All judoist subjects had a minimum number of five years of practice and no mechanical or functional instability from ligamentous, articular or muscle trauma or injury in the past three months. The perturbation test was performed by imposing a 10% body weight in 20 cm free-fall= without anticipation (Figure 1). An AMTI force plate (1000 Hz) was used to measure the reaction of participants with ground reaction force and COP trajectory. The balance response variables included maximum reaction force and balance performance variables including Maximum of Center of pressure (COP), total COP displacement, and averaged COP velocity. Three trials were collected for each test. Variables with length or weight units were normalized by height and weight of subjects, respectively. *T*-tests were performed between judoists and non-judoist groups.

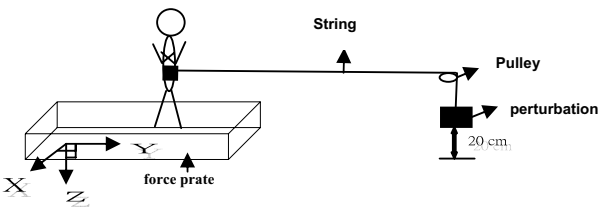

Figure1. Unanticipated direction-dependent perturbations

RESULTS AND DISCUSSION

In forward perturbation tests, both levels of judoists demonstrated significantly lower values than the non-judoist group for the COP averaged moving speed and total displacement (Table 1; p<.01). In addition, only the elite group showed significantly lower values for COP reaction force than the non-judoist group. Postural adaptations of judoist group are more efficient, especially for elite groups, than the control group. Judoists can change their intersegmentary coordination in order to accommodate specific unpredictable perturbation of tasks, as in the judo throwing attack (Seoinage-drop-knee). The main reason that judoists perform better in balance control is not due to leg muscle strength, which should yield greater reaction force, but because of balance control as demonstrated by lower reaction force with less COP displacement and lower COP moving speed.

Table 1 One-way ANOVA in National judoists (elite group), Regional judoists (subelite group) and Control group during unanticipated forward and backward perturbations

Forward	Group	m (SD)		One-way ANOVA		
N=14	National Judoists (N)	Regional Judoists (R)	Controls (C)	Fishers PLSD		
				N/R	R/C	N/C
Cop-X	0.07±0.07	0.09±0.06	0.56±1.68	NS	NS	NS
Cop-Y	0.08±0.02	0.1±0.03	0.61±1.73	NS	NS	NS
Fz	1.23±0.22	1.31±0.23	1.52±0.29	NS	NS	0.01
Avg velocity	66.5±22.4	77.6±11.8	99.9±22.5	NS	0.01	0.00
Length	261±88	305.5±46.6	415±73	NS	0.01	0.00
Backward						
Cop-X	0.17±0.03	0.15±0.01	0.15±0.01	NS	NS	0.02
Cop-Y	0.13±0.02	0.15±0.01	0.17±0.02	NS	NS	0.00
Fz	1.46±0.24	1.5±0.29	1.62±0.42	NS	NS	NS
Avg velocity	80±24.8	88.5±13.2	115±19.3	NS	0.00	0.00
Length	317±97	348±52	455±76	NS	0.00	0.00

In backward perturbation, both levels of judoists demonstrated significantly lower values than non-judoists for the COP-averaged moving speed and total displacement (p<.01). In addition, only the elite group showed significantly lower values for COP y direction displacement and greater values for COP x direction displacement (p<.01) than the control group. Elite judoists also tend to use more lateral movement skills to maintain balance and to control COP displacement. Postural adaptations of judo group are more efficient, especially for the elite group, relative control group.

CONCLUSIONS

In this study, elite and subelite judoists showed a postural adaptation strategy of significantly lower values for COP-averaged moving speed and total displacement, and also lower reaction force following unpredictable perturbation relative to the control group. Elite and subelite judoists did not differ significantly in these variables. Postural adaptations of judoists are more efficient, especially in the elite group. Kinetic parameters can be utilized to evaluate the efficient strategy in judo balance control for different attack directions.

REFERENCES

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