Original Article

The comparison of the role of vision on static postural stability in athletes and non-athletes

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Objectives: The goal of the present study was to compare the role of vision on static postural stability between athletes and non-athletes.

Methods: Participants included two groups of 25 persons, men Karatekas who were selected in Isfahan and healthy young men in Isfahan. All participants performed the static balance test on the force plate. Postural stability was measured and assessed during 35 seconds in a state of constant standing with paired feet in the center of the force plate in the two positions of eyes open and closed (3 trials in each positions) with random sequences. The rest between trials was 25 seconds. Parameters of mean velocity, standard deviation of velocity and standard deviation of amplitude in both anterior-posterior and medio-lateral plans from the center of foot pressure were recorded by the device. Two-way ANOVA was used.

Results: The test results showed that the interaction between vision and group did not exist. Closing the eyes led to a significant increase in postural sway in all parameters. Two parameters of mean velocity and standard deviation of velosity in medio-lateral plan were significantly greater in athletes than non-athletes.

Discussion: The findings can be considered for the design of exercises in karate and rehabilitation after sports injuries.

Keywords: vision, postural stability, athlete, balance

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Introduction

One important aspect of life is movement. Study in the field of motor control can improve learned skills and practical strategies will be applied to facilitate teaching motor skills for coaches, athletes, physiotherapists and occupational therapists (1). In the present study emphasis is put on sensory strategies involved in controlling balance and among available sensory afferents, the role of vision in postural control (balance), is emphasized.

Control of balance is one of the motor skills which is necessary in all activities, especially sports movements. Balance control is inversely related to injury and falling down, so it is important to study it (2,3). In order to have a more appropriate balance, it is necessary that the three afferent systems of proprioception, vision and vestibular provide the necessary information for this performance. It is evident that impairment of sensory organization of the above three systems leads to impaired balance control and injury will be likely. Therefore, the recognition of the participation pattern of these systems for balance, seems to be necessary because without such knowledge, the deficiency in the coordination between them is not possible. In this case injury prevention and rehabilitation after it will not be possible (1,4).

Severe dependence on visual cues during balance control can mean inadequate proprioceptive system, which may lead to injury and damage (1,5). Therefore, it seems that the prevention of injury and rehabilitation process after such circumstances will be conducted by the focusing on reducing visual dependency and improvement of proprioception.

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On the other hand, some studies have shown that the likely rate of visual dependency and the participation of the three sensory systems involved in balance control, is different in non-athletes and athletes (4-9). Based on Specificity of Practice Hypothesis, visual dependency during the execution of a motion depends on the individual, environment and task (6). In some sports (such as ballet and dance) strong visual dependency has been observed (6,10,11). Chapman et al. in their study also have cited the dependence on vision of surfers (12). In contrast, in some other sports, the characteristics of a task are such that these athletes have not that much dependency on vision (such as judo and triathlon) (7,13,14). Burfield and Fischman also in a soccer athletes study pointed on the importance of vision (15). So it seems that dependence on vision is related to the nature of the sport.

Due to the increasing tendency of people to the martial arts especially karate and naturally the possibility of the incidence of injuries associated with it, the related study would be useful. Also, since the ability to maintain stability in the performance of karatekas and that injury prevention and afterward rehabilitation is important, static balance task was selected to be evaluated in this study (16). Considering the possible relation among visual dependency, skills and sport injuries, study will be useful in this field. Therefore, the current study compared the role of vision on static postural stability between athletes and non-athletes.

Materials and Methods

The participants were two groups of 25. The athletes were selected from men karatekas of Isfahan province. Non-athletes group included healthy young men from Isfahan. Non athletes were matched with athletes for age, height and weight (Table 1). Sampling in this study was convenience non-probability sampling. All subjects with previous coordination referred to Isfahan Federation of Sports Medicine and after full examination by a physician and getting health certificate were provided with health insurance, and were selected to participate in this research. All subjects signed the consent form. To gather background information a questionnaire was prepared and was filled by the tester, including the name and surname, age, weight and height. Measurement instrument for postural stability in this study was Kistler force Plate Model 9281C with dimensions 60 × 40 cm which was made in Germany. All participants performed the static balance tests on the force plate. Subjects were placed in the center of force plate with their feet paired. Hands were kept hanging in all subjects during the test along with the body. Body and head were directly and easily kept and eyes watched the facing marker. Cross marker was drawn on a page and within two meters in front of the subject's eyes (17). During the test subjects were asked to stay on the center of force plate without moving and keep in constant looks at the cross marker. And for the tests that were performed with closed eyes, the subjects were told to gaze and keep looking at the cross indicator (17). Duration of each balance test was 35 seconds, to minimize the errors of examines and the instrument, the first 5 seconds were not analyzed (18). On the whole 6 general balance tests were taken from each subject. 3 tests with the eyes open and 3 tests with the eyes closed were conducted with random sequence. 25 seconds was allowed as rest time between tests in which the subjects sat on the seat beside force plate. Receptors in the force plate diagnosed the intensity and direction of forces from the feet and recorded them as electrical signals for the computer analysis. Sampling frequency was 100 Hz, and Butterworth Low - pass data filtering method, 10 Hz was selected. Dependent variables were average speed (mean velocity), speed standard deviation of velocity (in anteroposterior and mediolateral plans) and standard deviation of Amplitude (in anteroposterior and mediolateral plans) of the signals of center of foot pressure. In order to analyze data obtained independent t tests and two-way analysis of variance were used. Significant level in all tests was considered at $\alpha \leq 0.05$.

Results

Results indicated no significant difference between the background variables for athletes and non-athletes (Table 1). Table 2 shows the mean values and standard deviation of the variables in the study in the different conditions of vision of the two groups of athletes and nonatheletes. Using two-way ANOVA the main effects and interactions of vision and group on the variables of the center of pressure were evaluated (Table 3). Test results showed that the interaction between vision and the group does not exist. In other words, there is no significant difference among athletes and non-athletes in dependency on visual cues during control of static balance. Based on the findings, closing the eyes (regardless of group) led to a significant increase in all postural sway parameters ($0.001 > P$). On the other hand, regardless of vision, the two parameters of mean velocity and standard deviation of velocity in mediolateral plane in the athletes group were significantly greater than non-athletes ($0.05 > P$).

While in the three parameters of the standard deviation of velocity in anteroposterior plane and the standard deviation of amplitude in the anteroposterior and modiolateral plans no significant difference was observed between the two study groups (0.05<P).

Discussion

The results of this study showed that in all subjects closing the eyes increased postural sway. In other words all people rely on vision to maintain their balance. These findings are consistent with studies by Perrin, Gauchard, Simmonz, Williams, Burfield, Herringe and colleagues (3,6,7,14,15,17). Their studies found that if during task performance the visual cues is deleted, motor control would be at risk. These findings are reasonably justifiable because one of the main source of information for balance control is vision and it is used as a feedback from task performance. It is evident therefore that the loss of visual cues, will significantly affect motor control (1,5).

The findings of this study showed that speed variables in athletes were higher than nonathlets. In other words, the swing speed of the center of foot pressure in athletes is higher. But perhaps considering the amount of sway alone can not be a complete criterion for the interpretation of the full balance in athletes and the increase of the sway of Karatekas should not be considered as a limiting and confounding factor. It can be assumed that higher levels of variables in Karatekas group means higher variability of them which indicates a kind of exploratory behavior in the environment which means that athletes send more sensory information at any given moment to the central nervous system and try to discover the environment (11,19). Since balance control is an issue which is influenced by task characteristics, Karatekas will learn gradually during their training that for more compliance with sudden disturbances, they should keep better control on their posture while having more sway. Other findings showed that concerning the dependence on vision, there was no significant difference between the two groups. So perhaps characteristic of karate is that it is not so much related to visual cues and probably karatekas are more dependent on the balance proprioceptive systems as non-athletes. Therefore, when athletes are deprived of visual information they can ultimately improve their balance in comparison with non-athletes.

Similar studies are suggested to be conducted on samples of women and injured athletes.

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Table 1. Demographic characteristics of athletes and non-athletes

	Athlete Mean (SD)	Non-athlete Mean (SD)	p.value (Mean difference)
Age (yr)	20.64 (2.81)	21.56 (2.33)	0.21
Weight (kg)	66.24(10.34)	66.80 (11.34)	0.86
Height (m)	1.76 (0.07)	1.74 (0.08)	0.38
Body mass index (kg/m^2)	21.42 (2.91)	22.01 (2.90)	0.47
SD: standard deviation			

Table 2. Mean (SD) of COP measures in different visual conditions for athletes and non-athletes

	Athlete		Non-athlete	
	Eyes-open Mean (SD)	Eyes-closed Mean (SD)	Eyes-open Mean (SD)	Eyes-closed Mean (SD)
Mean velocity (cm/s)	1.42 (0.28)	2.06 (0.50)	1.18 (0.21)	1.85 (0.50)
AP				
SD of velocity (cm/s)	1.01 (0.20)	1.49 (0.38)	0.88 (0.19)	1.33 (0.31)
SD of amplitude (cm)	0.44 (0.17)	0.59 (0.21)	0.49 (0.15)	0.55 (0.16)
ML				
SD of velocity (cm/s)	1.37 (0.32)	1.93 (0.50)	1.07 (0.19)	1.74 (0.55)
SD of amplitude (cm)	0.44 (0.12)	0.73 (0.22)	0.47 (0.11)	0.67 (0.15)
OP: center of pressure; SD: standard deviation; AP: anterioposterior; ML: mediolateral.				

Table 3. Results of ANOVA for COP parameters in different groups and vision conditions

	Mean velocity (cm/s)		SD of velocity (cm/s) (AP)		SD of velocity (cm/s) (ML)		SD of amplitude (cm) (AP)		SD of amplitude (cm) (ML)	
	F	P	F	P	F	P	F	P	F	P
Group	4.93	0.03	3.90	0.05	5.41	0.02	0.00	0.98	0.16	0.69
vision	192.08	0.00	223.94	0.00	140.25	0.00	16.47	0.00	121.86	0.00
Vision*group	0.17	0.69	0.14	0.71	1.31	0.26	2.86	0.10	3.99	0.05
COP: center of pressure; SD: standard deviation; AP: anterioposterior; ML: mediolateral.										