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❖ VARIA

THE EFFECT OF EIGHT-WEEK PROPRIOCEPTION TRAINING PROGRAM ON DYNAMIC POSTURAL CONTROL IN TAEKWONDO ATHLETES

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ABSTRACT

Objective: The purpose of this study was to examine the effects of 8-week training proprioception program on dynamic postural control in active taekwondo athletes.

Procedures and Methods: In this study, training group consisted of 13 male and 13 female taekwondo athletes whereas control group consisted of 8 male and 8 female taekwondo athletes, 42 taekwondo athletes in all. The subjects of dynamic postural control performances were analyzed by Biodex marked device (Biodex, Inc., Shirley, and NewYork 950-302). The measurements were taken twice as before and after proprioception training program applied three times in a week and per week of 8. Package program SPSS for Windows 15.0 was used in the evaluation of data statistically. The results were evaluated at the significance level of 0,05.

Results: At the end of training program,while female taekwondo athletes of experimental group were observed to have more performance in dominant,non-dominant leg dynamic postural control test($p<0.05$),no difference was determined in double –leg ($p>0.05$).

It was seen that there was no performance difference in post-test double leg,dominant and non-dominant leg dynamic postural control scores of female taekwondo athletes of control group.($p>0.05$)Whereas a significant difference was observed in double-leg,dominant and non-dominant leg dynamic postural control scores gotten at the end of training program applied to the experimental group of male taekwondo athletes ($p<0.05$), no significant difference was found in dynamic postural control test scores of control group ($p>0.05$).

Conclusion: In conclusion, it was thought that proprioception training program improves of female and male taekwondo athletes dynamic postural control performances.

Key Words: Proprioception, Dynamic Postural Control, Taekwondo.

INTRODUCTION

Two aims of postural control including the control of body position in space are accomodation and balance. Postural accommodation is described as the ability of maintain the suitable relation between body and body parts, the conditions in special tasks (DA. Winter, et all., 1998). Balance is a general term expressing to the dynamic preventing falling into place of body mass (T. Aydın, et all., 2002). It means individuals' continuing their body positions in stable and different conditions related to the environment. In rest and activity times, It is the postural accommodation for displacement in the centre of gravity affecting body (K.N. Clark, 2004).

In sports, balance requires a complicated accommodation of inner and exterior inputs. Generally balance is controlled by sensory inputs, central process, neuromuscular answers, vestibular, visual and propreioceptive system (E. Aydog, et all., 2006). Each of the sports techniques includes balance in some way. Balance plays an important role in keeping body composition that is necessary for the successful performance in sports (M.A. Sandrey, 2006).

Postural control and propreioception are two dependent variables examined under balance training. It has been determined that postural control and propreioception are often developed through neuromuscular and propreioceptive training programs (A.S. Kemerley, 2001). The aim of propreioceptive training is to improve neuromuscular system for complicated activities. While static and dynamic activities are being applied, nervous systam enables body to keep its balanced position and makes information from periferal reseptors through efferent ways possible (S.G.T. Balter et all., 2004, J.L. Huston, et all., 2005, S.S. Salaj, D. Milanovic And I. Jukic, 2007).

Taekwondo is a movement sports and the balance which is important for athletes is the dynamic balance. Dynamic balance is required for giving a kick. Here, body is exposed to an exterior load, the centre of gravity always changes and generally increases. The feet are used as the most important factor in keeping balance (Kemerley A.S., 2001, Stefanek, K.,1998).

Stefanek says that dynamic postural control and balance are quite important for a taekwondo athlete and effective factors in applying techniques. He claims that the athlete should stand on support leg still in order

to apply an effective technique to the target area. He also points out that many taekwondo techniques are rather difficult and they potentially include both flexion and extension and dynamic postural control has an important role to apply true kick techniques in taekwondo sports (K. Stefanek, 1998).

The aim of this study is to examine the effect of eight-week propreioception training on dynamic postural control in active taekwondo athletes.

MATERIAL AND METHOD

Subjects

21 males and 21 females actively doing sports, 42 healthy athletes in all, participated in the study. The training group consisted of 13 male and 13 female taekwondo athletes and the control group consisted of 8 male and 8 female taekwondo athletes.

The subjects were chosen from the athletes who didn't have neurological, vestibular-visual illness in last one year and a serious lower extremity injury in last 6 months. Before application, subjects were told about the tests in the study and they were made to sign a document showing their volunteering. Ethical committee approval no 2009/186 was taken from Seljuk University Meram Medicine Faculty.

Postural control measurements

Biodex marked postural control system (Biodex, Inc., Shirley, New York 950-302) was used for dynamic postural control measurements. The measurements were done twice as before and after proprioception training program applied three times in a week and for 8 weeks. Subjects participated with suitable sports clothes for balance tests and as barefoot. Subjects were allowed to do enough practises to minimize the effect of learning before test.

The foot coordinates of subjects were determined and the same coordinates were used in all tests. Subjects applied the test as the knees were in a slight flexion 45, on dominant and non-dominat leg, the other leg was in 90' flexion from knee and arms were crossed on chest. During the test, the screen was closed and the subjects were told to look at a fixed point at eye level and one meter away. Dynamic control test was applied as at 3rd level ,with open eyes and on double leg, dominant and non-dominant leg. 3 repetitions for 20 seconds were done for each balance parameter. Breaks for 30 seconds were given between tests.

Figure 1: Biodex Postural Control System

Propreioception Training Program

The propreioception training program used in this study was adapted from exercise programs used in studies through literature scanning(Bert R. M. et all., 2005, Chong R.K. et all.,2001, Kemerley A.S. 2001, Lephart, S.M., et all.,1997, Paterno M. V. Et all. 2004, Söderman K. et all.,2000, Verhagen E.,2004).

8 –week process consisted of 5 –minute warming up, 20 –minute propreioception training program and 5-minute cooling parts and was for 30 minutes in all and applied 3 times in a week. Training sets were started with 10 seconds,6 repetitions and 10-second breaks between sets. After second week, repetitions numbers were slightly decreased, the time of standing on wobble board and break-time were increased 5 seconds and in last week ,the subjects applied each exercise on wobble board with 35 seconds,1 repetition and 35-second break. The subjects applied training in first 4 weeks as open-eyed and closed-eyed on smooth surface and wobble board. After 5 th week, subjects went on the training only on wobble board.

Double Leg Unilateral Leg

Figure 2: The sample from Proprioception Training

Statistical analysis

SPPS for Windows packet program was used in evaluating and calculating the acquired data. The measured variables were summarised by giving the

average and standard deviation. The normality distribution of measured parameters was determined through Shapiro-Wİlks test. Since data didn't have normal distribution,non-parametric tests were prefered in comparisons between groups. In pre-exercise and post-exercise, Mann-Whitney U test was used in comparison between experimental and control groups and Wilcoxon test was used for the comparison of differences between pre-test and post-test. In this study, the significance level was taken as 0.05.

FINDINGS

The demographic features of athletes participated in the study are shown in Table 1.

The pre-test and post-test comparison about dynamic postural control scores of all taekwondo athletes is seen in Table 2. At the end of statistical analysis, whereas no significant difference has been found in pre-test values, significant difference has been determined in post-test dynamic postural control scores($p<0.05$).

In Table 3, the comparison of pre-test, post-test dynamic postural control scores of female taekwondo athletes is seen. It has been found that double-leg, dominant leg, non-dominant leg dynamic postural control scores between experimental and control group have no significant difference ($p>0.05$).

The comparison of dynamic postural control scores before and after training program of experimental and control group of female taekwondo athletes is seen in Table 4. Whereas no significant difference is seen in double-leg dynamic postural control scores ($p>0.05$), a significant difference has been found between dominant and non-dominant leg pre-tast and post-test dynamic postural control scores ($p<0.05$).

In table 5, the comparison of pre-test, post-test dynamic postural control scores of experimental and control group of male taekwondo athletes is seen. No significant difference has been found in double-leg and dominant leg pre-test dynamic postural control scores between experimental and control group ($p>0.05$). As for post-test dynamic postural control scores,whereas a significant difference has been found in double-leg and dominant leg between experimental and control group ($p<0.05$), no significant difference has been determined in non-dominant leg dynamic postural control scores ($p>0.05$).

In table 6, the comparison of before and after training program dynamic postural control scores of experimental and control groups of male taekwondo athletes is seen. Whereas a significant difference is seen in all dynamic postural scores of experimental group ($p<0.05$), no significant difference has been found in control group ($p>0.05$).

DISCUSSION and CONCLUSION

In this study, examining the effects of 8-week proprioception training program on dynamic postural control in active taekwondo athletes has been aimed.

Postural control and balance are described as the ability of making adaptations to keep body's gravity centre on support surface or maintain these adaptations (M.A. Hoffman, V.G. Payne, 1995, A.S. Kemerley, 2001). These adaptations happen through ankle, knee and hip's movements and may be destroyed when gravity centre and support surface are damaged (Kean C.O., 2006). In researches, postural control was examined with the aim of applying various training programs in individual and team sports, preventing its effect and injuries (R. M. Bert, et all., 2005, R.K. Chong et all.,2001, M. V. Paterno, Et all. 2004, K. Söderman, et all., 2000, E. Verhagen, 2004). In these studies, it was reported that at the end of balance trainings carried out, force improved and muscular imbalance decreased (J.A. Balogun, et all. 1992, H.C. Heitkamp, et all. 2001).

In this study, when the dynamic postural control scores measured after training program were examined, it has been found that experimental group taekwondo athletes have higher dynamic postural control performance than control group and they are statistically significant. Although taekwondo naturally requires basic posture and techniques improving dynamic postural control. it has been determined that the propreioception training program applied to the experimental group improves taekwondo athletes' dynamic postural control performances.

In their studies where they investigated the effect of proprioception training program on healthy people, Hoffman and Payne (1995) applied a training program being for 10weeks and 3 days in a week to the experimental group. Pre-test, post-test dynamic postural control results of the subjects were gotten through Kistler Force Platform. They found that dominant leg dynamic postural control scores of experimental group significantly improved when compared to the control group. Also,they reported that propreioception training program increased the dynamic postural controls of subjects and could be useful for person movement (Hoffman and Payne, 1995).

In their studies on figure skaters, Kovacs and his friends researched the effect of neuromuscular training program on postural control. In the research, whereas experimental group (n=22) applied neuromuscular program for 4 weeks and 4 days in a week, the control group (n=22) applied basic training program only for figure skating. Before and after training, the subjects' postural controls were measured on a force platform and in the light of the acquired results; experimental group was found to have rather improved their dynamic postural control performances when compared to the control group (E.J. Kovacs, et all.2004). Beside these findings show parallelism with the acquired results, they also support propreioception training program in addition to the athletes' training programs that are peculiar to their own branches.

Whereas experimental group female takwondo athletes were found to have higher performance in

dominant, non-dominant leg dynamic postural control test after training program, no difference was found in double-leg.

In their studies, Paterno and his friends (2004) examined the effect of 6-week neuromuscular training program on female handballers' postural controls. 41 female handballers studying in high school participated in research and a 6-week and 20-minnute propreioception training program was applied to the athletes 3 days in a week. The postural controls of all athletes were measured by Biodex Stability System. After training program, they found that there were important improvements statistically about handballers' double-leg, dominant and non-dominant leg postural controls. Also,they described balance training as the exercises that could be included in planned and various trainings that were focussed on maintain the balance without change on support surface and postural awareness(M.V. Paterno, et all., 2004).

In a research carried out by Holm and his friends (2004), 35 Elite female handballers participated and propreioception training program was applied to the players. The handballers' dynamic postural controls were measured by KAT (Kinesthetic Ability Trainer) 2000 device before and after the training. At the end of pre-test, post-test comparison, they reported that the applied training program improved female handballers' dynamic postural controls and prevented possible injuries (I. Holm et all. 2004). These results of the research show parallelism with the findings of our study.

Lephart and his friends (1997) reported that regular training increased the development in neuro-sensory and motor ways and decreased the risk of injury by affecting propreioception sense positively (S.M. Lephart, et all., 1997).

A significant difference was found in double-leg, dominant and non-dominant leg dynamic postural control scores acquired at the end of the training program applied to the experimental group of male taekwondo athletes. Also, whereas a significant difference was found in double-leg and dominant leg in the comparison of post-test dynamic postural control scores of experimental and control groups, no difference was seen in non-dominant leg. In taekwondo trainings, generally dominant leg and fists are effectively used. Whereas dominant leg techniques are hard and effective, non-dominant leg techniques are weaker and away from necessary technical level. In our study, at the end of comparison of experimental and control groups' dynamic postural control scores after propreioception training program; the reason why no significant difference was found in non-dominant leg dynamic postural control scores is thought to result from athletes' using their bodies unilaterally.

Gioftsidou and his friends (2006) examined the effect of balance program on footballers. 39 footballers participated in the research. While control group (n=13) continued only the football trainings ,one of the other experimental groups (n=13) applied the balance program before football training and other experimental group(n=13) applied after football training. Balance program was applied for 12 weeks,3 days in a week and 20 minutes in a day. The balance skills of athletes were evaluated by Bıodex Stability System. At the end of comparisons of pre-test,post-test, significant differences were determined in both of the experimental groups' balance skills (Gioftsidou A. et all.,2006).

A similar research was carried out by Malliou and his friends (2008). In their sutides where they examined the effect of balance program applied before and after the regular tennis training on upper-level tennis players, while control group only applied tennis training, one of the experimental groups applied balance program before tennis training and other applied after tennis program. The balance performances of all tennis players participated in the study were measured by Bıodex Stability System and players participated in balance program for 12 weeks, 3 days in a week and 16 minutes. At the end of 12 weeks, whereas no significant difference was found in control group, they reported an important development in dynamic balance performances of experimental group (V.J. Malliou, et all. 2008).

In a research where the effect of propreioception training program was examined on dynamic postural control, while propreioception training program was being applied to the football experimental group 2 days in a week and for 20 minutes during the competition season, the control group only continued the football training.Also, dynamic postural control tests of footballers were measured by Bıodex Stability System. At the end of the research,it was determined that propreioception training program improved footballers' dynamic postural control performances and the rate of injury decreased (C. Hrysomallis, 2008). It is seen that the results of the research show parallelism with our study and support the findings of our study.

The limitedness of this research is that the athletes did the training in two different halls and with two diffeent trainers although training surfaces and weekly training numbers were the same. It is thought that taekwondo athletes' were being trained by only one trainer in later studies will reflect the possible changes on postural control performance beter.

To conclude, It has been observed that propreioception training program improves the dynamic postural controls of male and female taekwondo athletes. Giving place to the studies that can improve propreioceptive features in Taekwondo trainings may help the athletes increase their postural controls to the maximum level. As a result of this, it is thought that the performances about technical applications of taekwondo athletes in trainings and competitions may increase and possible disabilities may be prevented.

Table 1: Female and Male of Taekwondo Athletes Demographic Characteristics (Mean ± SD)

Variables	*Groups*	*N*	*Female*	*Male*
Age (Year)	**Experiment**	13	20,92 ± 1,55	20,23 ± 2,80
	Control	8	20,75 ± 1,66	19,87 ± 2,29
	Total	21	20,85 ± 1,56	20,09 ± 2,56
Height (cm)	**Experiment**	13	166,77 ± 8,36	174,85 ± 6,97
	Control	8	165,62 ± 7,59	173,75 ± 5,06
	Total	21	166,33 ± 7,90	174,43 ± 6,20
Weight (kg)	**Experiment**	13	56,69 ± 6,89	62,80 ± 4,95
	Control	8	61,50 ± 7,27	70,50 ± 14,55
	Total	21	58,52 ± 7,26	65,74 ± 10,17
BMI (kg/m^2)	**Experiment**	13	20,36 ± 1,72	20,58 ± 1,94
	Control	8	22,41 ± 2,40	23,27 ± 4,17
	Total	21	21,14 ± 2,20	21,61 ± 3,18
Sports Age (Year)	**Experiment**	13	9,23 ± 2,31	8,62 ± 2,56
	Control	8	6,00 ± 1,07	6,23 ± 1,36
	Total	21	8,00 ± 2,49	7,14 ± 2,19

Table 2: All of Taekwondo Athletes Comparison Pre-Test And Post-Test of Dynamic Postural Control Scores

Dynamic Postural Control		**Groups**	**Female**	**Male**	**U**	**p**
Pre-Test	**Double Leg**	**Experiment**	1,91 ± 0,56	1,98 ± 0,31	175,50	0,398
		Control	1,85 ± 0,50	2,34 ± 0,54		
	Dominant Leg	**Experiment**	2,20 ± 0,56	2,57 ± 0,58	129,50	0,058
		Control	2,45 ± 0,48	3,06 ± 0,58		
	NondominantLeg	**Experiment**	2,37 ± 0,89	2,83 ± 1,10	144,00	0,097
		Control	2,86 ± 0,82	3,22 ± 0,93		
Post-Test	**Double Leg**	**Experiment**	1,65 ± 0,55	1,69 ± 0,34	107,00	0,009*
		Control	1,92 ± 0,71	2,46 ± 0,42		
	Dominant Leg	**Experiment**	1,90 ± 0,66	1,90 ± 0,48	60,00	0,000*
		Control	2,45 ± 0,74	3,33 ± 0,95		
	NondominantLeg	**Experiment**	1,88 ± 0,70	1,90 ± 0,54	110,00	0,011*
		Control	2,30 ± 0,49	2,55 ± 0,72		

** P<0.01 * P<0.05

Table 3: Experiment and Control Group of Female Taekwondo Athletes Dynamic Postural Control Scores Comparison of pretest-posttest Values

Dynamic Postural Control		**Groups**	**Means**	**U**	**p**
Pre-Test	**Double Leg**	**Experiment**	1,91 ± 0,56	49,00	0,828
		Control	1,85 ± 0,50		
	Dominant Leg	**Experiment**	2,20 ± 0,56	38,00	0,309
		Control	2,45 ± 0,48		
	Nondominant Leg	**Experiment**	2,37 ± 0,89	37,00	0,276
		Control	2,86 ± 0,82		
Post-Test	**Double Leg**	**Experiment**	1,65 ± 0,55	39,50	0,364
		Control	1,92 ± 0,71		
	Dominant Leg	**Experiment**	1,90 ± 0,66	26,00	0,059
		Control	2,45 ± 0,74		
	Nondominant Leg	**Experiment**	1,88 ± 0,70	31,50	0,137
		Control	2,30 ± 0,49		

Table 4: Experiment and Control Group of Female Taekwondo Athletes Dynamic Postural Control Scores Comparison of pretest-posttest Values

Variables		Z	p
Experiment Groups	Double Leg	-1,170	0,242
	Dominant Leg	-1,992	0,046*
	NondominantLeg	-2,503	0,012*
Control Groups	Double Leg	-0,509	0,611
	Dominant Leg	-0,105	0,917
	NondominantLeg	-1,542	0,123

*P<0.05

Table 5: Experiment and Control Group of Male Taekwondo Athletes Comparison Pre-Test And Post-Test of Dynamic Postural Control Scores

Dynamic Postural Control		Groups	Mean	U	p
Pre-Test	Double Leg	Experiment	1,98 ± 0,31		
		Control	2,34 ± 0,54	28,500	0,089
	Dominant Leg	Experiment	2,57 ± 0,58		
		Control	3,06 ± 0,58	25,000	0,053
	NondominantLeg	Experiment	2,83 ± 1,10		
		Control	3,22 ± 0,93	34,000	0,190
Post-Test	Double Leg	Experiment	1,69 ± 0,34		
		Control	2,46 ± 0,42	5,00	0,001**
	Dominant Leg	Experiment	1,90 ± 0,48		
		Control	3,33 ± 0,95	2,50	0,000**
	NondominantLeg	Experiment	1,90 ± 0,54		
		Control	2,55 ± 0,72	26,00	0,058

** P<0.01

Table 6: Experiment and Control Group of Male Taekwondo Athletes Comparison Pre-Test And Post-Test of Dynamic Postural Control Scores

Variables		Z	p
Experiment Groups	Double Leg	-2,251	0,024*
	Dominant Leg	-2,719	0,007*
	NondominantLeg	-3,102	0,002*
Control Groups	Double Leg	-0,562	0,574
	Dominant Leg	-1,051	0,293
	NondominantLeg	-1,549	0,121

* P<0.05

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