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The Effect of Coordination Training Program on Learning Tennis Skills

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Abstract

The aim of this study was to define which coordination abilities are the most important in tennis and to identify whether a coordination training program will improve the learning process of tennis skills (backhand and forehand). Fifteen expert coaches in tennis completed a check list of five coordination abilities and suggested that the most important coordination abilities for tennis players are "kinaesthetic differentiation" and "reaction time". Based on the results from the questionnaires, the program designed to practice the two most important coordination abilities. Participants were 48 novice children (age 11 ± 2 years). They were randomly divided into two group, the experimental group (EG, n=24) and the control group (CG, n=24). Both groups followed a tennis training program 3 times/wk for eight weeks. Participants of the experimental group performed a specific coordination program for 20 min before the skills practice and participants of the control group performed the traditional practice. The tennis skill performance and learning assessed using observation technique in five basic elements of every skill. There were three measurements, pre, post and retention test, one week after post test without practice. Analysis of Variance (ANOVA) with repeated measures (2 group X 3 measures) revealed that there was significant interaction between groups and measures. The Bonferroni post hoc analysis revealed that the experimental group performs better than the control group in the post test and in the retention test in the two skills. The results of this study indicated that coordination training program help athletes to learn and perform the forehand and backhand tennis skills better.

Key words: Coordination abilities, kinaesthetic differentiation, reaction time, tennis skill

Introduction

In sports where technique is of great importance, it is essential all athletes could perform refined skills. Tennis is a sport which demands a high level of coordination abilities (1). The term "coordination" has been defined in the literature as the ability to perform complex motor skills. Hirtz, (2, 3) suggested a list of 5 basic coordination abilities: reaction, rhythm, balance, kinaesthetic differentiation and space - time orientation. Practicing the coordination abilities seem to be necessary and has to take place during childhood and adolescence, as a form of an "additional technique training" (4). This term includes additional drills that will improve virtuosity, stability and the coordination of special sport techniques. In most sports the training of skill alone is not enough for learning and stabilizing the new skill, thus, there is a need for specific drills which will facilitate the learning process of the skill. Previous studies (5, 6) developed a theory with regard to the coordination requirements for each sport. The abilities of coordination (specific for each sport) are "hidden" under each sport skill and facilitate athletes to maximize their performance in this skill (6, 7).

Derri, Mertznidou and Tzetzis (8) evaluated dynamic balance and body coordination between athletes (rhythm and gymnastics) and non athletes and found that athletes had significantly better dynamic balance and body coordination. Also, it was proposed that the athletes should be practiced with sport specific coordination drills in order to optimize their performance.

Furthermore, Starosta, Rostkowska and Kokoszka (9) studied the water feeling at water sports with the use of questionnaires based on the 5 basic coordination abilities: reaction, rhythm, balance, kinaesthetic differentiation and orientation. The questionnaires were given to athletes from different water sports (swimming, synchronized swimming and diving) and to their coaches. The study showed that different swim phases depended differently on the coordination abilities.

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The efficiency of coordination training in sports was supported by the results of experimental studies carried out on basketball players (17), handball players (10), football players (men and women) (11, 12) volleyball players and kick boxers, tae kwon do, single combats (Greco-Roman and free-style wrestling) (13) and on judo (14). A study with young tennis players (15) proposed that the abilities which contribute mostly on proper service motion were: body coordination, reaction time and the ability of throwing at a target.

Although coordination abilities are essential learning requirements in order to perform well and to develop optimal tennis strokes and movement technique (1), there are not many studies in tennis with regard the use of coordination abilities in learning process of basic skills.

The aim of the present study was to define which coordination abilities are the most important for tennis players and to identify if an additional coordination training program will improve the learning process of the tennis skills (backhand, and forehand).

Method

Participants

In the present study there were 48 novice athletes (22 male and 26 female) of sport club, aged between 9 – 13 years old (11 ± 2 years). They were randomly divided into two groups, the experimental group (EG, n = 24) and the control group (CG, n = 24). The participants had training experience in tennis one year. These individuals voluntarily participated in this experiment.

Identification of coordination abilities

In order to identify which coordination abilities are the most important in tennis players, questionnaires were given to 10 expert tennis coaches. They were asked to evaluate the coordination abilities from the most important to the least important for tennis players. The coordination abilities that were valued: 1) kinaesthetic differentiation, 2) space and time orientation, 3) rhythm, 4) reaction and 5) balance. Based on these results the two most significant abilities were selected as tennis specific coordination abilities and an intervention programme was planned. Kinaesthetic differentiation, with regard to the movement perception, was defined as the ability that allows a player to control internal and external information, adapt it and use it correctly. Space and time orientation is the ability to determine and modify the position and movements of the body in space and time according to the tennis court and/or an object in motion (tennis ball and opponent). Rhythm was defined as the ability to capture an acquired rhythm from an external source and to reproduce it in movement. Reaction is the ability to identify simple or complex situations rapidly and find the appropriate motor solution. Finally, balance was defined as the ability to maintain perfect body position during stroke performance (static) and recover the initial position (dynamic).

Intervention Program

Based on the results from the questionnaires, the coordination program was designed to practice the two most important abilities: the kinaesthetic differentiation and reaction time. The intervention was a specific coordination program and performed before the tennis training session for eight weeks, three times per week. In each session the participants practiced four drills for five minutes each. Special attention was given to make the drills fun and appropriate for athletes' age and training experience.

Procedure of measurements

All participants had five minutes warm-up, and then performed 10 backhand and 10 forehand strokes period. These activities were recorded by a video-camera for the initial technique evaluation (pre-test). An expert tennis coach evaluated the backhand and forehand technique at five basic elements: i) the grip, ii) the side-way stance, iii) the elbow position before the touch, iv) the touch and v) the follow through.

A score was given for each participant (ten trials X the score of the sum of five elements of skill). After five weeks, when the intervention program was completed, a technique evaluation (post-test) for all players took place in the same way as the initial measurement. Finally after a week, without practice in these two skills, a technique evaluation (retention test) was performed to all players in order to examine if the participants learned the skills.

Statistical analysis

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The Pearson (r) correlation was performed between the measurements from one day to the next day (test, retest) by an expert coach in tennis, in order to evaluate the observer's internal reliability. There was high correlation in test and retest (r=0.97, p=0.000).

A one-way ANOVA determines if there were initial differences between groups in the two tennis skills. Two-way repeated measures ANOVA was used to test the difference in the technique performance of the skills in three measurements (pre, post, and retention test) between the two groups (EG and CG). The Bonferroni test was used for the post hoc analysis where appropriate. The level of statistical significance was set at $p< 0.05$.

Results

Initial measurements

The data were normally distributed. The one-way ANOVA revealed no significant differences between the groups EG (Experimental) and CG (Control group) at pre-test in backhand ($F_{1,47} = 0,68$ $p > 0.05$) and forehand ($F_{1,47} = 0,44$ $p > 0.05$), which means that the two groups were began experiment with a similar level of technique.

Performance in Forehand

The two-way repeated measures ANOVA revealed significant interaction between the groups ($F_{2,92} = 46,36$, $p < 0.000$) and measurements, main effect of measurements ($F_{2,92} = 161,22$, $p < 0.000$) and main effect of group ($F_{1,46} = 73,58$, $p < 0.000$). Mean and standard deviation for each group are presented in Table 1.

Specifically revealed significant differences in technique performance of forehand between groups EG and CG at post test ($p < 0.05$) and at retention test, a week after the completion of the intervention without practice, there was still a significant difference between group EG and CG ($p < 0.05$). LSD post-hoc analysis revealed that there were significant differences from pre to post-test and from pre-test to retention test of participants of the experimental group. This means that the participants of the experimental group were better than the participants of the control group in forehand skill technique performance (Figure 1).

Performance in Backhand

Two-way repeated measures ANOVA revealed significant interaction between the groups ($F_{2,92} = 26,94$, $p < 0.001$). In addition, a main effect for measurement ($F_{2,92} = 114,08$, $p < 0.000$) and group ($F_{1,46} = 19,49$, $p < 0.000$) was revealed.

Specifically revealed significant differences in technique performance of backhand between groups EG and CG at post test ($p < 0.05$) and at retention test, a week after the completion of the intervention without practice, there was still a significant difference between group EG and CG ($p < 0.05$). Mean and standard deviation for each group are presented in Table 2.

LSD post-hoc analysis revealed that there were significant differences from pre to post-test and from pre-test to retention test of participants of the experimental group. This means that the participants of the experimental group were better off than participants of the control group in backhand skill technique performance (Figure 2).

Discussion

Coordination abilities are essential in order to develop and perform optimal tennis strokes (forehand and backhand) and the movement techniques (1). The aim of the present study was to define which coordination abilities are the most important for tennis players and to identify if an additional coordination training program will improve the learning process of the tennis skills (backhand, and forehand). Specifically it was suggested that kinaesthetic differentiation and reaction are the most important abilities for tennis. Thus, coordination exercises targeting those abilities as supplementary to tennis training sessions can improve the learning process of the backhand and forehand technical elements.

The results revealed that participants of the experimental group learned the two tennis skills (backhand, and forehand). The present findings for young tennis players aged 9 – 13 years old are in agreement with the bibliography (4). It was supported that coordination abilities are basic elements for an athletic skill. Also, practicing those abilities with specific exercises has a better result at improving the technique of those skills (16). Differentiation and reaction seem to be valuable in tennis as in other sports. Zwierko, Lesiakowski, and Florkiewick, (17) showed that coordination abilities such as orientation, differentiation, reaction, balance and the technical skills are necessary parts of the basketball players' practice.

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Martin (18) claimed that kinaesthesia is very important for movement perception and motor skills learning. It has been suggested that kinaesthetic ability is developing rapidly until the age of ten and the well – trained persons are quite superb at this ability (8).

Roloff (19) suggested as a person's kinesthesia develops, the possibility of learning new motor skills increases. A study with volleyball players (20) found that rhythmic ability is important, while kinaesthetic differentiation ability is limited to this sport. In addition a study in rhythmic gymnastics (21) mentioned the importance of kinaesthesia to high performance. Also, it has been reported a relationship between reaction and the performance for basketball players (22, 23) karate athletes (24). A study which examined eye-hand and eye-foot reaction showed that there was significant difference between soccer players and non-athletes (25).

In general, in tennis the ability to react quickly at the net or on the return of serve or to volley a high-speed passing shot is very important (1). In addition, the present study showed that improving the ability to react with an additional training program to tennis practice, has a positive effect on the learning process of the technique of backhand and forehand. It has been suggested that age is related to coordination abilities and that there was a linear relationship between age and coordination performance for ages 4 – 7 years old (26). Participation in tennis by itself cannot develop coordination abilities. The training of children should be focused on versatile education corresponding to certain needs. Delimitation of this study was that the intervention lasted only 8 weeks and the long learning and retention of skills were not assessed in the present experiment.

Conclusions

According to the results of the present study, the ability of kinaesthetic differentiation and reaction are primary connected to high performance tennis skills. Furthermore, practicing those abilities will help to improve the learning procedure of the backhand and forehand complex technique.

Applications in Sport

Coordination abilities are important during tennis play, and their development from the early age is essential. Specifically, coaches who work with young players will have to include coordination exercises into their daily training program through which these tennis specific coordination abilities will be practiced. In this way the learning procedure will be more fun, and not through a classic, "boring" program. The goal for the coaches is not only the technique improvement but also, to fulfil the need of young players for fun.

Tables

Table 1

Means and standard deviations of participants of two groups in forehand skill

Group	Sex		Pre-test		Post-test		Retention-test	
	N	Boys	Girls	M	SD	M	SD	M	SD
Experimental	24	14	10	14.58	1.7	28.08	5.6	28.54	4.7
Control	24	11	13	14.25	1.7	19.04	1.8	17.88	3.9
Total	48	25	23	14.42	1.7	23.56	6.1	23.21	6.9

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Table 2
Means and standard deviations of participants of two groups in backhand skill

Group	Sex		Pre-test		Post-test		Retention-test	
	N	Boys	Girls	M	SD	M	SD	M	SD
Experimental	24	14	10	26.54	9.4	41.23	5.2	44.4	3.3
Control	24	11	13	24.44	8.2	29.98	9.9	30.38	9.2
Total	48	25	23	25.5	8.8	35.60	9.7	37.39	9.8

Figure 1
The performance in technique evaluation of groups in forehand

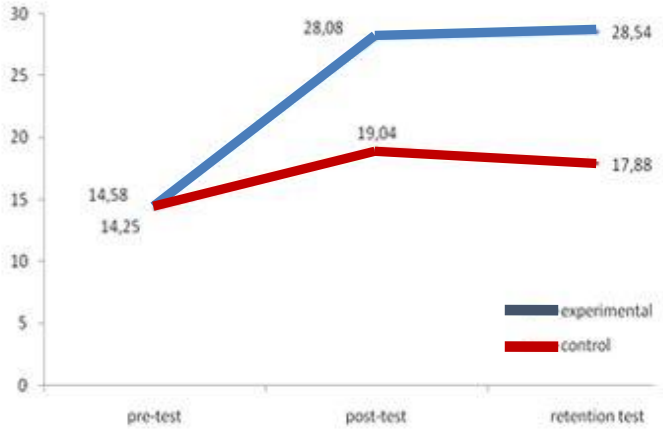
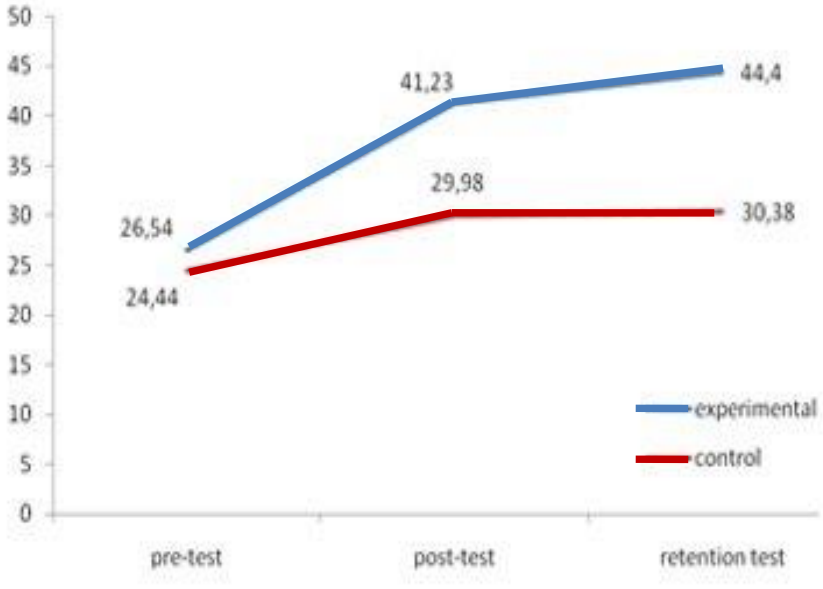


Figure 2
The performance in technique evaluation of groups in backhand



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