EFFECTS OF 8-WEEKS WHOLE BODY VIBRATION TRAINING ON SOME MARKERS OF TENNIS PERFORMANCE

Ismail Bayram [1], Ali Onur Cerrah[1], Deniz Simsek[1], Hayri Ertan[1]

Faculty of Sport Sciences, Coaching Education Department, Anadolu University, Eskisehir, Turkey.

The aim of the current study was to investigate the effects of Whole Body Vibration (WBV) training on some tennis performance parameters like International Tennis Number (ITN) scores, serve speed, reactive agility (with and without racket), 5m, 10m, 20m sprint and isokinetic strength values. 19 tennis players (training group: 9, control group: 10) participated in the research as volunteers. All the selected parameters were measured before and after the training protocol. While control group was following regular tennis training, intervention group practiced WBV training for eight weeks (3 times a week, 1 level up for every fortnight, 15-20 mins per section). Consequently, it has been revealed that WBV training made an increase in selected performance parameters of athletes.

KEY WORDS: ITN test, serve speed, sprint, reactive agility

INTRODUCTION: It is known that WBV might increase intra-muscular and inter-muscular coordination of the muscles and consequently, could improve some motoric features such as strength, speed and flexibility by making an impact on especially muscle spindles and golgi tendon organs (Albasini et al., 2010).

Many studies in the literature focused on the effects of WBV training on muscle strength (Roelants et al., 2006; Wang et al., 2014), repeated sprint performance (Ronnestad and Ellefsen, 2011), flexibility (Cochrane and Stannard, 2005; Fagnani et al., 2006) and reported positive results related to WBV after training period.

ITN on Court Assessment test was created by International Tennis Federation in 2003 and it consists of five different section (Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve and Mobility). It is an easy and effective tool to assess performance levels of especially recreative, beginner and middle level tennis players. Despite of its weaknesses (i.e. stable ball feeding, assessment of the stroke in a closed environment, only main strokes' assessment) it has been using by tennis coaches widely all around the world (http-1).

Serve is the only closed skill of the game and it has been seen the most important and difficult stroke of the tennis game (Sweeney et al., 2012). An effective serve requires not only appropriate strength but also a proper kinetic chain from bottom to up. Elliott (2006) reported the impact percentages of different joints which contribute serve speed as: %40 shoulder internal rotation, %30 palmar flexion, %15 arm horizontal flexion. ITN test and serve speed are strong indicators of tennis performance in this regard.

Another motoric feature which is closely related to tennis performance is agility which has been described in the literature in different ways. Agility is *"the ability of change of direction speedily"* (Lloyd et al., 1994) or more briefly "react against a stimulus" (Young et al., 2001). Other scientists improved this definition by adding perceptual motor learning, decision making, visual recognition, pattern recognition, anticipation and awareness components (Sheppard and Young, 2006). In tennis game all the balls comes from rival has a different type, velocity, spin percentage and based on this variables they drop to different areas of the court. Because of these features, tennis players need to have a really good reaction time and an explosive strength for the split step (Groppel, 1986). Tennis is a game built on unpredictability. Game length, stroke selection, strategy, game duration, environmental conditions and game characteristics of the opponent has an impact on the complex physiology of tennis (Kovacs,

2006).

Despite its popularity and benefits there is no any study in the literature investigated performance based results of WBV training in tennis players. Even though WBV training contributes different motoric features, it is unclear and there is no consistent evidence which of the selected parameters cause the increase of tennis performance. Therefore, the aim of this research was to assess the effect of WBV on some selected performance parameters of tennis like International Tennis Number (ITN) scores, serve speed, reactive agility (with and without racket), 5m, 10m, 20m sprint speed and isokinetic strength values and which variable strongly influence tennis performance.

METHODS: 19 university level tennis players participated in the research voluntarily. Nine of these volunteers comprised the training group (age: 21,55±2,69 year, training age: 32,44±13,42 month, height: 171,44±8,06 cm, body mass: 63,66±12,62 kg) and 10 of them were the control group (age: 21,40±2,59 year, training age: 37,30±21,74 month, height: 172,10±9,82 cm body mass: 64,90±11,22 kg). Some arrangements were made to remove the human factor (feeding was made with a ball throwing machine (Prince Deluxe Professional II, Atlanta, USA)) in ITN test and serve speeds were measured with a radar device (The JUGS Gun, Tualatin, OR, USA) within the ITN test. Reactive agility and sprint tests were measured by electronic timing system (Smart Speed; Fusion Sport Pty, Ltd, Brisbane, Queensland, Australia). Isokinetic strength values (concentric/concentric) were measured for three joints in total for internal/external rotations with 90 degrees shoulder abduction position, knee flexion/extension and hip flexion/extension by using ''Isomed2000 isokinetic dynamometer'' (D&R Ferstl GmbH, Hemau, Germany). Only dominant legs and arms of athletes were tested in 60^0.s-1 angular speed with three maximal repetitions. After the measurement procedure, training group practiced WBV training on a platform (Compex, Winplate, Canada) which has incrementally increasing performance levels for eight weeks from 1 to 4, three times a week and one level up for every fortnight. The recommendations given by Kleinöder (2009) has been followed during the training period.

Since the data shows a normal distribution, Two-way Anova were used for each group to analyze and see if there are any differences between pre and posttest values of designated independent variables. Statistical significance was taken as $p < 0.05$ in all test.

RESULTS and DISCUSSION: After 8 weeks WBV training, training group showed signs of improvement in every selected parameter with varied percentages but none of these improvements were statistically significant ($p < 0.05$) except ITN test, shoulder internal and external rotation. Control group also showed improvements for 10m sprint, knee extension/flexion and shoulder external rotation parameters but they were not statistically significant ($p < 0.05$).

Table 1. Pre and Post Tests Two-Way Anova Values

Dependent Variable	test	Mean	Std. Error	Significance F	Sig.
itn test	Pre test	179,778	12,073	4,909	,034
	Post test	217,606	12,073		
serve speed	Pre test	103,733	5,282	1,928	,174
	Post test	114,106	5,282		

reactive agility 1	Pre test	1,922	,051	,503	,483
	Post test	1,871	,051		
reactive agility 2	Pre test	2,028	,045	,582	,451
	Post test	1,979	,045		
sprint 5m	Pre test	1,148	,032	,233	,632
	Post test	1,126	,032		
sprint 10	Pre test	2,012	,050	,613	,439
	Post test	1,957	,050		
sprint20	Pre test	3,495	,088	1,138	,294
	Post test	3,362	,088		
knee flexion	Pre test	72,433	6,661	3,410	,074
	Post test	89,828	6,661		
knee extensiom	Pre test	162,006	14,013	1,232	,275
	Post test	184,006	14,013		
hip flexion	Pre test	90,289	12,341	1,344	,254
	Post test	110,522	12,341		
hip extension	Pre test	136,778	21,618	1,086	,305
	Post test	168,633	21,618		
shoulder_int_rot	Pre test	57,522	4,416	5,305	,028
	Post test	71,906	4,416		
shoulder_ex_rot	Pre test	23,311	2,203	5,283	,028
	Post test	30,472	2,203		

Reactive Agility1 represents with racket and Reactive Agility2 represent without racket. The unit of serve speed is km/h (kilometers per hour), sec (second) for agility and sprit and Nm (Newton meter) for all strength values.

ITN scores and serve speed of the training group increased %41.55 and %15.04, respectively after 8 weeks WBV training while it was %4.11 for ITN scores and %5.05 for serve speed in control group. Reactive agility (with and without racket) of the training group increased %6.47 and %6.16, respectively after 8 weeks WBV training while it was %0,31 for Reactive agility with racket and -%0,49 for without racket in control group. 5m,10m 20m sprints increments were %1.2, %2.92 and %4.07 in training group and %2,5, %2,53 and %3,51 in control group. Different amount of increments also have been elicited related to isokinetic strength values of the training group after training period. Even though training group showed varied absolute and relative percentages of improved selected parameters Two-way Anova showed that they were not statistically significant **(Table 1).**

CONCLUSION: Consequently, results shows that 8 weeks WBV training, which is performed three times a week before the regular tennis training sessions, positively affected tennis performance by increasing mainly strength and sprint abilities of the players and this lead the player to increase their INT scores. Improvements observed on shoulder internal and external rotation strength might be increase the serve accuracy of tennis players. Statistical differences

on ITN scores interpreted that the tennis performance of the players showed signs of improvements after WBV training. On the other hand, more research needed to fully understand the effects of WBV on tennis performance of different age groups and performance levels. Also some parameters were quite close to significant level ($p < 0.05$) therefore increase of participant number might give more reliable results.

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