STUDIA UBB EDUCATIO ARTIS GYMN., LX, 3, 2015, pp. 27 - 34
(RECOMMENDED CITATION)

TRX SUSPENSION TRAINING METHOD AND STATIC BALANCE IN JUNIOR BASKETBALL PLAYERS

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ABSTRACT. Introduction: Described as an ingenious physical preparation method, suspension training was developed based on the concept of instability. This study was aimed at finding out if three weeks of TRX suspension training were enough to enhance static balance in junior basketball players. **Materials and methods:** Twelve male junior basketball players from the "U" Mobitelco club of Cluj-Napoca participated in this research. The subjects were randomly divided into two groups: Experimental (n=6) and Control (n=6). For three weeks, three TRX suspension training sessions per week were performed by all athletes from the Experimental group. Anthropometric measures (weight, height and arm span) were performed on all participants prior to suspension training. Static balance, assessed as the excursion of the center of pressure (COP), was measured with an AMTI® force platform (model BP400600, Advanced Mechanical Technology Inc., Watertown, MA, USA) on both legs, before and after the training period. **Results:** Mean age of participants was 13.33 ± 0.49 years, mean height was 173.05 ± 6.56 cm, mean weight was 59.14 ± 24.38 kg, and mean arm span was 171.58 ± 8.85 cm. No significant changes were found between the mean values of chosen COP parameters corresponding to the Experimental and to the Control group, respectively. **Conclusions:** Three weeks of TRX suspension training seem to be insufficient for modifications to occur in the static balance of junior basketball players. For future studies, a longer training period should be considered in order to see if there are any ways in which the TRX method affects static balance in junior athletes.

Keywords: static balance, center of pressure, TRX training method, junior basketball players

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REZUMAT. ***Metoda de antrenament TRX şi echilibrul static la baschetbalişti juniori.*** **Introducere:** Descrisă ca o metodă ingenioasă de pregătire fizică, antrenamentul realizat prin suspensie a fost dezvoltat pe baza conceptului de instabilitate. Acest studiu a avut ca scop investigarea rezultatelor unui program de antrenament cu durata de trei săptămâni obţinut cu ajutorul sistemului TRX asupra echilibrului static al baschetbaliştilor juniori. **Materiale şi metode:** La acest studiu au participat doisprezece baschetbalişti juniori din cadrul clubului "U" Mobitelco din Cluj-Napoca. Participanţii au fost împărţiţi aleatoriu în două grupe: Experimentală (n=6) şi de Control (n=6). Timp de trei săptămâni, sportivii din grupa Experimentală au efectuat câte trei antrenamente pe săptămână utilizând TRX-ul. Înainte de perioada de antrenamente, toţii subiecţii studiului au participat la măsurători antropometrice (înălţime, greutate, anvergura braţelor). Echilibrul static, evaluat ca excursia centrului de presiune (CDP), a fost măsurat cu o platformă AMTI® (model BP400600, Advanced Mechanical Technology Inc., Watertown, MA, USA) în cazul ambelor membre inferioare, atât înainte cât şi după perioada de antrenamente. **Rezultate:** Vârsta medie a participanţilor a fost de 13.33 ± 0.49 ani, înălţimea medie a fost de 173.05 ± 6.56 cm, greutatea medie a fost de 59.14 ± 24.38 kg şi anvergura medie a braţelor a fost de 171.58 ± 8.85 cm. Nu s-au observat diferenţe semnificative din punct de vedere statistic între valorile medii ale parametrilor centrului de presiune corespunzători valorilor măsurate în cazul grupelor Experimentală şi, respectiv, de Control. **Concluzii:** Trei săptămâni de antrenament cu metoda TRX par a fi insuficiente pentru a fi observate modificări în ceea ce priveşte echilibrul static al baschetbaliştilor juniori. Pe viitor, ar trebui luată în calcul o perioadă de antrenament mai lungă pentru a investiga dacă există vreo modalitate în care antrenamentul cu TRX afectează echilibrul static al sportivilor juniori.

Cuvinte cheie: *echilibru static, centru de presiune, metoda de antrenament TRX, jucători de baschet juniori*

Introduction

Human beings maintain equilibrium by keeping their centre of gravity over their base of support. The ability of maintaining equilibrium is called balance (Browne & O'Hare, 2001). Balance can be physiologically assessed by measuring a human's sway. Calculating the displacement of a subject's centre of gravity (COG) is considered a direct method, while calculating the movement of a subject's centre of pressure (COP) is acknowledged as an indirect method of evaluating balance (Browne & O'Hare, 2001). In static or slow moving conditions, according to Winter (1995), cited by Browne & O'Hare (2001), the COP can approximate the COG.

Described as an ingenious training method, suspension training was developed based on the concept of instability. Performing exercises (push-ups) in conditions of instability leads to increased muscle activation, especially in rectus abdominis muscle (Calatayud et al., 2014). Regarding postural muscles, suspension training is considered an effective technique for enhancing their strength (Pastucha et al., 2012).

Objective

This study was aimed at finding out if three weeks of TRX suspension training were enough to enhance static balance in junior basketball players.

Materials and methods

Participants

The subjects of this research were twelve male junior basketball players from the "U" Mobitelco club of Cluj-Napoca. All known health risks associated with suspension training were explained to the participants and written informed consent was obtained from them. None of the subjects dropped out from the study. Research protocol was approved by the Ethics Committee of the Faculty of Physical Education and Sport, Babeş-Bolyai University of Cluj-Napoca.

Procedures

Designed as a randomized controlled trial, this study consisted of three weeks of training, three times per week, with the TRX® Suspension Trainer. The subjects were randomly divided into two groups: Experimental (n=6) and Control (n=6). The duration of a training session was approximately 45 minutes. After a general warm-up of about 10-15 minutes, the subjects from the Experimental group performed 15 exercises using the TRX® Suspension Trainer (15 minutes). Each training session was finalized with 10-15 minutes of stretching. The chosen TRX exercises targeted the lower body (ex: squats, sprinter starts, hamstring curls), the upper body (ex: back row, chest press), and the core (ex: suspended plank, suspended crunches).

Anthropometric measures (weight, height and arm span) were performed on all participants prior to suspension training. Static balance, assessed as the excursion of the center of pressure (COP), was measured with an AMTI® force platform (model BP400600, Advanced Mechanical Technology Inc., Watertown, MA, USA). A personal computer, the AMTI MSA-6 Amplifier System and an analog

data acquisition system (A/D converted at 16-bit resolution) were used to record the data. The force platform measured the three force components, Fx, Fy and Fz, and the three moment components, Mx, My and Mz (x, y and z are the medial–lateral, anterior–posterior and vertical directions, respectively) (Harringe, Halvorsen, Renström & Werner, 2008). Bioanalysis with Netforce, version 2.4.0 (AMTI's Biomechanics Software), was used to compute COP measurements. The COP parameters took into consideration were: 95% ellipse area (cm^2), mean COP anterior–posterior and medial–lateral direction (cm), and path length (cm).

Subjects were tested in conditions of unipodal stance (stance on one leg) and open eyes. Participants stood barefoot on the platform, with both left and right leg. They were asked to look straight ahead, to keep their arms relaxed and close to the trunk, and to flex their opposite lower limb. Data recording started as soon as the subject was positioned correctly on the platform and lasted for 30 s. The measurements were carried out both before and after the training period.

Analyses

Means, standard deviations and standard errors were calculated for all data. The independent-samples t-test was used to investigate whether there are significant differences between the two groups of subjects regarding the selected COP's parameters, and a paired-samples t-test was used to compare data recorded pre and post-training. A $p \leq 0.05$ was considered statistically significant. The analyses were carried out in IBM SPSS, version 20.0.

Results

Mean age of participants was 13.33 ± 0.49 years, mean height was 173.05 ± 6.56 cm, mean weight was 59.14 ± 24.38 kg, and mean arm span was 171.58 ± 8.85 cm. Table 1 presents the results of an independent-samples t-test applied to data recorded, before and after three weeks of training, from subjects belonging to both Experimental and Control group.

Table 1. Independence-samples t-test's results

COP's parameters	T1			T2		
	t	p	Mean Difference	t	p	Mean Difference
COP-X Avg (cm) - Left foot	0.891	0.406	1.28	-0.299	0.771	-0.38
COP-Y Avg (cm) - Left foot	0.633	0.541	0.27	-1.438	0.181	-2.50
95% Ellipse Area (cm^2) - Left foot	1.168	0.270	44.38	0.934	0.393	56.54
Path Length (cm) - Left foot	0.997	0.342	68.77	0.719	0.489	67.15

COP's parameters	T1			T2		
	t	p	Mean Difference	t	p	Mean Difference
COP-X Avg (cm) - Right foot	0.687	0.508	0.91	-0.350	0.734	-0.50
COP-Y Avg (cm) - Right foot	-0.367	0.722	-0.18	0.889	0.395	1.13
95% Ellipse Area (cm^2) - Right foot	0.995	0.365	30.99	0.995	0.365	41.07
Path Length (cm) - Right foot	0.846	0.418	63.09	1.005	0.338	139.58

* T1 – initial testing; T2 – final testing; p<=0.05

No significant changes were found between the mean values of chosen COP parameters corresponding to the Experimental and to the Control group, respectively.

Table 2 presents the results of a paired-samples t-test applied to data recorded from all participants, before and after three weeks of training. There are no significant changes between the mean values of chosen COP parameters computed from data recorded before and after the training period, for both groups of subjects (Experimental and Control).

Table 2. Paired-samples t-test's results

T1-T2	Experimental group			Control group		
	Mean	t	p	Mean	t	p
COP-X Avg (cm) - Left foot	1.41	-0.699	0.516	2.70	1.726	0.145
	1.91			1.52		
COP-Y Avg (cm) - Left foot	0.49	-1.738	0.143	0.77	1.633	0.163
	1.04			-1.45		
95% Ellipse Area (cm^2) - Left foot	16.68	-1.311	0.247	61.07	-0.709	0.510
	15.51			46.51		
Path Length (cm) - Left foot	170.52	-1.843	0.125	239.30	-1.836	0.126
	175.42			238.52		
COP-X Avg (cm) - Right foot	1.02	-1.293	0.253	1.94	0.643	0.548
	1.84			1.33		
COP-Y Avg (cm) - Right foot	-0.51	-1.134	0.308	-0.70	-1.533	0.186
	-0.24			0.88		
95% Ellipse Area (cm^2) - Right foot	15.51	0.046	0.965	46.51	-0.960	0.381
	15.42			56.50		
Path Length (cm) - Right foot	209.54	-0.725	0.501	276.69	-1.361	0.232
	188.02			327.60		

* p<=0.05

Mean values of COP's parameter entitled 95% Ellipse Area, corresponding to data recorded from unipodal stance (right leg), both before and after the training period, for all participants, are shown in Figure 1. Figure 2 has the same meaning as Figure 1, except data were recorded from unipodal stance (left leg).

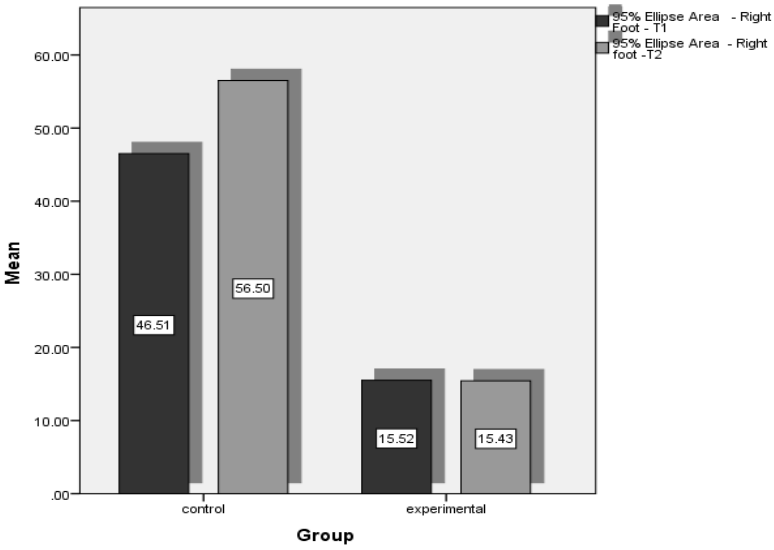

Figure 1. Mean values for 95% Ellipse Area (right leg)

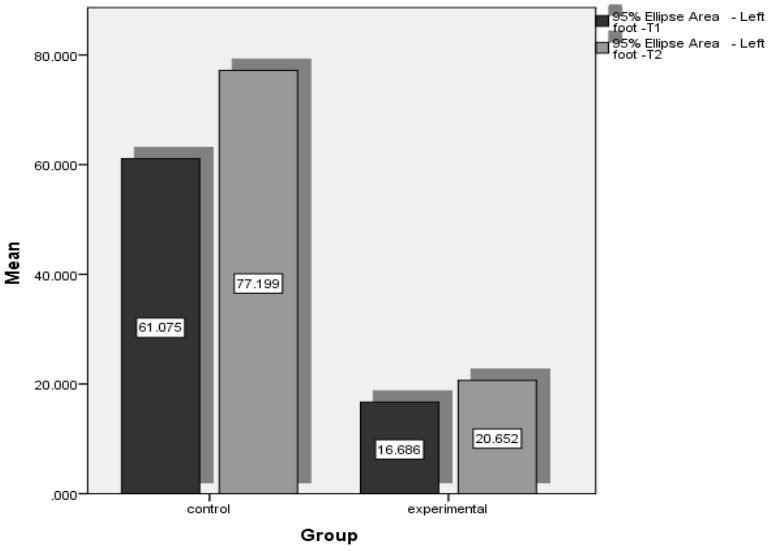

Figure 2. Mean values for 95% Ellipse Area (left leg)

Discussion and conclusions

In recent years, the interest expressed by sport scientists regarding suspension training grew proportionally with the increase in its popularity among coaches and athletes. The great majority of published studies approach muscle activation aspects during suspension exercise.

Pushing exercises were analyzed when performed traditionally and in suspension. Push-ups performed with TRX were associated with greater activation of torso muscles and with greater range of compression than traditional push-ups, but standard push-ups showed significantly higher shear force than TRX push-ups (McGill, Cannon & Andersen, 2014). Another study investigated the electromyographic activity of pectoralis major, anterior deltoid and triceps brachii during the performance of traditional and suspension push-ups. Results indicate that higher activation of the aforementioned muscles was recorded while participants performed suspension push-ups rather than when they performed traditional push-ups (Snarr & Esco, 2013).

Suspension training was proved to be beneficial for core muscles. Rectus abdominis, external oblique, internal oblique/transversus abdominis, and superficial lumbar multifidus presented higher activation levels during suspension training when compared with traditional training (Mok et al., 2014). The performance of a frontal plank exercise with a TRX® Suspension Trainer was documented to increase activation of abdominal muscles when compared to the floor based plank (Byrne et al., 2014).

To the extent of our knowledge, the present study is the first one to approach the effects of TRX® Suspension Trainer on static balance. Findings suggest that static balance parameters were not significantly improved by suspension training in junior basketball players. Thus, three weeks of TRX suspension training seem to be insufficient for modifications to occur in the static balance of junior basketball players. For future studies, a longer training period should be considered in order to see if there are any ways in which the TRX method affects static balance in junior athletes.

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