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EFFECTS AND DIFFERENCES IN POSITIONS DURING VIBRATION TRAINING ON THE CAUDAL MUSCULATURE

(Original scientific paper)

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Abstract

Mechanical vibration of the whole body has recently been attracting a lot of interest. During the explosive strength training gravity g = 9.81 ms 2 has a very important role, and this vibration plate changes conditions of the action of gravity. The results of the training effect may have frequency vibration amplitudes, as well as the position of the respondent takes the vibrating plate. The position depends primarily on which muscle groups will be most active during the training. The aim of this study is to determine the effects and differences of different positions on the vibrating plate. During the research 40 male respondents participated, average age 14.02 ± 1.18, the average body weight of 59.90 ± 11.99, average body height 168.57 ± 8.77. Divided into four groups: control (K) group of 10 subjects, which were not included in the plate, the experimental (E1) group, which occupied a normal upright position on the vibrating plate, (E2), a group that has occupied the position of the squat and (E3) group, which is occupied the position of a deep squat. Myotest included the execution of the half squat jump (CMJ) as well as a jump from a squat (SJ) defined variables: HightC, PowerC, ForceC, VelocityC, HightS, PowerS, ForceS, VelocityS, the maximum weight of thruster legs (leg press) 1RM. Vibration training lasted six weeks, three times a week period of stimulation per workout was 6 minutes, with 8 repetitions of 45 seconds, and a break between repeating of 30 to 60 seconds. Frequency of vertical vibration varied from 30Hz to 40Hz and the amplitude of the vertical displacement of 3-5 mm. Results: Based on the results found, it can be concluded that the different positions of the vibrating plate lead to different results. Normal upright position leads to improvements in explosive power compared to the initial measurement of the sig = 0.005, while the position of the high and deep squatting leads to an improvement compared to the initial measurement of the significance of the sig = 0.002. They are also visible and intergroup differences in the final measurement between E1 and E2, and between E1 and E3 with the sig <0.001. Conclusion: It can be concluded that the position of the squat during training at the vibro plate further engage the muscles of the lower extremities.

Keywords: *vibration plate, explosive power, boys, vibration training, normal upright position, position of the high and deep squatting, multiple analysis of variance*

INTRODUCTION

Mechanical vibration of the whole body has recently been attracting a lot of interest. Basco et al. (1998) showed that the vibration affects the increase in muscle strength and their flexibility. In this study he also examined the effect of 10-d vibration on muscle power, where the vibration of 10 min x d-1 increases explosive power.

During the explosive strength training gravity g = 9.81 ms 2 has a very important role, and this vibration plate changes conditions of the action of gravity. Vibration training in addition to the power increase (Roelants, Delecluse, & Goris, 2004.; Roelants, Delecluse & Verschueren, 2004), has a positive effect on bone density (Verschueren, Roelants & Delecluse, 2004), as well as the physical status (Roelants, Delecluse, & Goris, 2004.) because it has great popularity in medicine, physical preparation of athletes and the rehab. Vibration training increases muscle temperature and accelerates the circulation (Issurin & Tenenbaum, 1999). The results of the training effect may have frequency vibration amplitudes, as well as the position of the respondent takes the vibrating plate. The position depends primarily on which muscle groups will be most active during the training.

Vibration training works best with passive subjects, while within athletes these results are much weaker (Cardinale & Basco, 2003.; Delecluse, Roelants, & Verschueren, 2003). The research of Rønnestad, (2009.). proves that passive respondents had a significantly higher growth rate in force at CMJ jump, while Bautmans, Van Hees, Lemper & Mets (2005.) determined that vibration training has an impact on balance, mobility and muscle performance of the elderly. Different frequencies of vibration have different effect on force (Da Silva et al, 2006.). Research that shows the impact of different types of exercises and positions on the vibrating plate is very small (Rolents, Verchuren, Delecluse, Levin, &Stijnen, 2006).

The aim of this study is to determine the effects and differences of different positions in training on the vibrating plate.

METHODS

During the research 40 male respondents participated, average age 14.02 ± 1.18, the average body weight of 59.90 ± 11.99, average body height 168.57 ± 8.77. Divided into four groups: control (K) group of 10 subjects, which were not included in the plate and has not performed any physical activity that could affect the explosive power of the lower extremities, experimental (E1) group, which occupied a normal upright position on the vibrating plate, (E2), a group that has occupied the position of the squat where the angle of the knee joint was 125 º and the angle of the hip joint 145º and (E3) group, which is occupied the position of a deep squat with angle in the knee and hip of 90 °. All respondents who were involved in the training process were completely healthy, with no hidden injuries.

Using Myotest and execution of the half squat jump (CMJ) and jump from a squat (SJ) following variables were determined:

(CMJ)
1 HightC (height in cm)
2 PowerCore (power expressed in W / kg),
3 ForceC (force expressed in N / kg),
4 VelocityC (acceleration expressed in cm / s).

(SJ)
1 HightS (height expressed in cm)
2 PowerS (power expressed in W / kg),
3 ForceS (force expressed in N / kg),
4 VelocityS (acceleration expressed in cm / s).

Determined the maximum weight of thruster legs (leg press) in a repeating, formula weight / (1.0278-(0.0278 x number of repetitions) = 1RM (Brzycki, 1993)

1RM (expressed in kg)

Protocol of training

After the initial measuring of respondents who were involved in training the vibrations of the vibrating plate (Power-Plate, Badhoevedorp, The Netherlands). Training vibration lasted six weeks, three times a week the total period of stimulation per workout was 6 minutes, with 8 repetitions of 45 seconds, and a break between repeating of 30 to 60 seconds. Frequency of vertical vibration varied from 30Hz to 40Hz depending on the week, as well as the amplitude of the vertical displacement of 3-5 mm (Bautmans, Van Hees, Lemper, & Mets, 2005.). Additional physical activity that could affect the course of the study was not allowed.

Data Processing

All data was analyzed with the program “SPSS 11”. Variable power shown by the descriptive statistics, separately for each group and how the initial and the final measurement went. To determine the differences in the arithmetic means the respondents use analysis of variance with one factor (ANOVA) and multiple analysis of variance (MANOVA).

RESULTS

From Table 2. we can conclude that there were no statistically significant differences between the groups in the initial measurement sig> 0005.

From Table 3. it can be seen that in the final analysis, a statistically significant difference between K and E1 groups sig = 0.000; E1 and E2 sig = 0.001; E1 and E3 sig = 0.000 was found, while between E2 and E3 groups there were no statistically significant differences sig = 0.236.

In Table 4. it can be seen that at RM1 variables there were no statistically significant differences between the groups sig> 0005 were found. In K vs E1 differences do not exist only in VelocityS sig = 0.010; E1 vs. E2 there are no differences in the PowerC, sig = 0.023; PowerS sig.= 202; between E1 vs. E3 differences exist not

Table 1. Protocol of training

Week	Frequency	Amplitude	Duration repe-tition x times	Break
1	30Hz	3mm	8 x 45s	30-60s
2	35Hz	3mm	8 x 45s	30-60s
3	40Hz	4mm	8 x 45s	30-60s
4	30Hz	4mm	8 x 45s	30-60s
5	35Hz	4mm	8 x 45s	30-60s
6	40Hz	5mm	8 x 45s	30-60s

Table 2. Intergroup differences in the initial measurement of the variables in the multivariate level power

Effect		Value	F	Hypothesis df	Error df	Sig.
K vs E1	Wilks' Lambda	.126	7.682[a]	9.000	10.000	.192
K vs E2	Wilks' Lambda	.571	.834[a]	9.000	10.000	.602
K vs E3	Wilks' Lambda	.578	.812[a]	9.000	10.000	.618
E1 vs E2	Wilks' Lambda	.305	2.529[a]	9.000	10.000	.382
E1 vs E3	Wilks' Lambda	.321	2.354[a]	9.000	10.000	.099

Table 3. Intergroup differences of the final measurements of variables forces the multivariate level

Effect		Value	F	Hypothesis df	Error df	Sig.
K vs E1	Wilks' Lambda	.053	19.700[a]	9.000	10.000	.000
E1 vs E2	Wilks' Lambda	.057	18.343[a]	9.000	10.000	.000
E1 vs E3	Wilks' Lambda	.043	24.592[a]	9.000	10.000	.000
E2 vs E3	Wilks' Lambda	.409	1.602[a]	9.000	10.000	.236

Table 4. Intergroup differences of the final measurements in variable power of the univariate level

Dependent variable	K vs E1		E1 vs E2		E1 vs E3		E2 vs E3	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.
HeightC	22.180	.000	13.924	.002	16.257	.001	.760	.395
ForceC	16.322	.001	49.107	.000	61.682	.000	.411	.529
PowerC	11.713	.003	6.224	.023	12.048	.003	.963	.340
VelocityC	12.902	.002	10.378	.005	16.036	.001	.369	.551
HeightS	26.356	.000	36.560	.000	41.930	.000	2.594	.125
ForceS	14.691	.001	15.081	.001	59.796	.000	12.890	.002
PowerS	11.211	.004	1.756	.202	2.732	.116	.036	.852
VelocityS	8.384	.010	14.887	.001	15.336	.001	.166	.688
RM1	.216	.648	2.660	.120	.039	.845	1.115	.305

Table 5. Intragroup differences between the initial and final measurements of variables forces

Grupa	Effect	F	Hypothesis df	Error df	Sig.
K	Wilks' Lambda	43.235[a]	8.000	2.000	.423
E1	Wilks' Lambda	6.762[a]	8.000	2.000	.005
E2	Wilks' Lambda	10.742[a]	8.000	2.000	.002
E3	Wilks' Lambda	28.589[a]	8.000	2.000	.002

only at PowerS sig = 0.116. Between E2 vs. E3 group differences exist only within ForceS sig = 0.002, while all other variables sig> 0005 remain unchanged.

Table 5. shows that there was no statistically significant difference between the initial and final measurements in the K group sig = 0.423, while for the other groups there was statistically significant difference in the E1 group sig = 0.005, with E2 and E3, sig = 0.002. In Table 6. it can be seen that K groups improved almost non-existent or was deteriorated

Table 6: Descriptive indicators of variables forces the initial and final measurement

Groups	K group		E1 group		E2 group		E3 group	
Measurments	Initial	Final	Initial	Final	Initial	Final	Initial	Final
HeightC	28.19	30.27	23.20	27.04	26.69	32.04	26.44	34.21
ForceC	24.15	22.16	26.33	26.72	27.68	38.06	26.49	39.20
PowerC	33.57	33.37	42.38	43.11	39.10	50.86	39.78	53.94
VelocityC	198.4	191.3	208.4	213.7	205.9	229.6	208.5	233.6
HeightS	25.55	28.84	20.39	22.24	22.52	31.05	23.85	33.66
ForceS	24.73	24.83	26.05	29.39	24.64	34.43	25.24	39.08
PowerS	40.67	40.38	40.13	49.30	38.88	53.78	42.36	54.33
VelocityS	217.4	215.8	208.7	231.5	207.0	250.2	220.1	251.7
RM1	57.4	57.3	51.8	55.7	57.5	60.6	50.7	56.5

(ΔHeightC = 2,8cm; ΔForceC = -1.99 N kg; ΔPowerC = -0.2 W/ kg; ΔVelocityC = -8.1 cm/s; ΔHeightS = 3.29 cm; ΔForceS = -0.1 N/kg; ΔPowerS = -0.29 W/ kg; ΔVelocityS = -1.6 cm/s), while the largest increase was in the E3 group (ΔHeightC = 7 , 77cm; ΔForceC = 12.71 N/kg; ΔPowerC = 15,16 W/kg; ΔVelocityC = 25.1 cm/s; ΔHeightS = 19,81 cm; ΔForceS = 14.84 N/kg; ΔPowerS = 11, 97 W/kg; ΔVelocityS = 30 cm/s) when comparing E2 and E3 group no statistical significance in the differences in the final measurements was noticed, but the results of the final measurements in E2 and E3 groups were statistically significant compared to the results of the E1 group (ΔHeightC = 3,84cm; ΔForceC = 0.39 N/kg; ΔPowerC = 0.73 W/kg; ΔVelocityC = 5.3 cm/s; ΔHeightS = 1,85 cm; ΔForceS = 3.34 N/kg; ΔPowerS = 9.17 W/kg; ΔVelocityS = 22.8 cm/s).

DISCUSSION

As in other studies (Roelants et al., 2004.; Bosco et al., 1998.;) whole body vibration training has had a positive impact on the explosive power of the lower extremities. In normal upright position on the vibrating plate, there was a statistically significant difference in the variables of explosive strength sig = 0.005, which is also the case in the study of Roelants et al. (2006.), also in this study there was a much higher growth in the deep squat position (90 °, 90 °;) sig <0.001; the plate position in relation to the high squat (125º; 145º;), sig = 0.005. The difference between the research of Roelants et al. (2006) in relation to the current is that the high squat had minor changes sig = 0.005 as compared to the current sig = 0.002. Deep squat position on the vibrating plate has made positive and identical results in both studies sig = 0.002. The positions of the high and deep squat on the vibrating plate led to significant improvements in the variables of explosive strength sig = 0.002, but there was no statistically significant difference between E2 and E3 groups sig = 0.236, while between E1 and E2 and E1 and E3, sig <0.001 there was. Roelants et al. (2006) in his research also came to the conclusion that there was no statistically significant difference between the upright position during the treatment of the vibrating plate and the deep squat on the vibrating plate with significance sig <0.005. The vibro training not only had an impact on variable RM1 where in all cases sig> 0.005, ie. there was no statistically significant change in the maximum ejection during thrust legs (leg press).

CONCLUSION

Whole body vibration training has led to desired results in the variables of explosive strength, while at maximum power (RM1) there was no statistically significant change sig> 0005. On the basis of the results found it can be concluded that the different positions of the vibrating plate lead to different results. Normal upright position leads to improvements in explosive power compared to the initial measurement of the sig = 0.005, while the position of the high and deep squatting leads to an improvement compared to the initial measurement of the significance of the sig = 0.002. There are also visible intergroup differences in the final measurement between E1 and E2, and between E1 and E3 with the sig <0.001. Based on these results it can be concluded that the position of the squat during training on vibration further engage the muscles of the lower extremities and leads to intensive improvements in explosive force.

It is necessary to carry out more research within this field, whole body vibration training is a relatively new type of training because it must examine its effect on other motor skills, and how it affects the vertical moving in relation to the horizontal movement of plate compactors.

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