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Original Article

Effects of the eight-week resistance training program using stable and unstable surfaces to arms and shoulders' muscular strength parameters with untrained individuals

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Abstract:
The performance of resistance training using unstable surfaces (e.g. Swiss balls, BOSU balls, balance discs, etc.) has not only became a part of everyday training programmes for sportspeople, but also programmes for amateurs. Sports trainers' thoughts on this matter differ. Some of them think that training using unstable surfaces is the one that should be the basic strength training, while the others think that this type of training should be only used as an additional training, regarding the type of trainings functioning as injury protection, rehabilitation, body weight control and strength. Observing the field of rehabilitation, there is an enormous number of results and surveys that prove the meaning and purpose of this type of training. There is far less number of surveys that approve or disapprove the implementation of resistance training using unstable surfaces with untrained individuals. This work aims exactly to identify the modification of muscles parameters with healthy untrained adult male individuals through scheduled training programme using unstable surfaces. The implemented training programme has lasted eight weeks together with the previous technical training that had lasted four weeks. The examinee were separated into two experimental groups of thirty people who were doing the barbell chest press exercise in six series of eight repetitions with the two-minute break between the series with the 50% weight of the previously determined weight of one maximum repetition (1 RM) in stable conditions (flat bench) and unstable conditions (Swiss ball). The obtained results proved the justification of the usage of this training programme regarding the absolute and relevant strength values increasing with untrained individuals regardless of the kind of surface. In addition, implemented training programme mentioned does not lead to force increasing neither in stable nor unstable conditions.
Key words: muscular parameters, resistance training, unstable surfaces, stable surfaces, untrained individuals.

Introduction

The performance of resistance training using unstable surfaces has become a part of the training and preparatory activities for athletes as well as everyday sports and recreational activities of citizens. An increasing number of trainers, sports experts and sports professionals advocate the use of resistance training using unstable surfaces (Kibele & Behm, 2010). Naturally, their opinions differ. One believe that the training using unstable surfaces should be the basis of strength training, while the others believe that this type of training should be done as additional training, i.e. as training for injury prevention, rehabilitation, body weight and strength control only (Zemkova and et al. 2010; Panza et al. 2014).

Considering the rehabilitation sector, the training using unstable surface is being used to its fullest (Hibbs et al. 2008). The performance of resistance training using unstable surfaces with untrained individuals has not been explored much. Based on the former research results on muscular strength in sport as well as with untrained individuals and the usage of modern training technologies and measuring instruments, the main objective of this work is to find out the quality indicators which are going to direct us to the possibilities of implementation of this training in sport, i.e. training activities that ought to contribute in developing motor skills of athletes and enhancing their achievements.

Materials and methods

This research has been done as a classical two-group experiment in which 60 participants were included and divided into two experimental groups. The examinees were healthy adult amateur men who haven't had an organised and scheduled exercise system before. This experimental programme lasted for eight weeks including previous four-week training on proper techniques of work out to develop muscular force and strength. After the training on techniques, before starting the experimental programme, an initial measuring of muscle parameters

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was made. Based on the initial measuring, each examinee was given 50% weight of the previously determined weight of one maximum repetition (1 RM).

First experimental group of examinees did the resistance training, i.e. they did the barbell chest press in unstable conditions at the gym (Swiss ball) and the second experimental group of examinees did the same training but in different conditions – in usual stable conditions at the gym (flat bench). Both groups were exercising twice a week, a total of 16 training sessions. The data collected was tested in laboratory conditions using specially designed system for assessing myogenic abilities (FitroDyne Premium, Fitronic, Slovakia) and then statistically processed. In order to obtain objective and valid data, all examinees were introduces with the aim of the research, as well as with the testing methodology.

Assessment of the maximal musculature of the arm and shoulder force was measured in normally equipped gym at the Faculty of Physical Education and Sport facilities in Banja Luka, where the musculature which is assumed to be dominant in making numerous movements in different sports and recreation was measured. A complex movement, known as Bench Press - a classical resistance exercise, was made in this phase of testing.

The dynamic stress method was applied in assessing arms and shoulders' muscular parameters using standard weight (barbell) on the Bench Press with the 55%, 60%, 65% weight (1RM).

Statistical analysis of the attained results was divided into two parts – descriptive statistics and inferential statistic methods. Regarding descriptive statistics, which implies describing collected data during research or measurement and its arranging, central and dispersion parameters were calculated at the whole-sample level: number of respondents (**N**), arithmetic mean (**M**), standard deviation (**SD**), standard error of the mean (**SE**), variation (**Min – Max**). Regarding inferential statistic method, which is used for sample analysis and finding validity or differences within or between samples, a t-test for dependent and independent samples and covariance analyse were used in this research.

Table 1. Characteristics of the groups

Surfaces		**N**	**Min**	**Max**	**M**	**SD**
	Age	30	20.00	26.00	22.00	1.86
Stable	Body height (cm)	30	169.00	187.50	179.77	5.01
	Body weight (kg)	30	68.10	115.40	85.99	13.59
	Age	30	19.00	29.00	22.65	2.60
Unstable	Body height (cm)	30	170.00	192.00	182.60	6.74
	Body weight (kg)	30	69.20	107.60	83.36	9.65

Results

The values of the gained force, expressed in absolute units, using stable and unstable conditions with the 55%, 60%, 65% weight (1RM) are presented as follows:

Table 2. Results of gained force (N) with the 55%, 60% and 65% weight of 1RM

Force 55%	**N**	**M**	**SD**	**SE**	**t**	**p**
Stable initial	30	431.33	74.38	13.58		
Stable final	30	432.74	74.85	13.66	-1.582	0.125
Unstable initial	30	348.68	91.47	16.70		
Unstable final	30	337.52	65.97	12.04	1.099	0.281
Force 60%						
Stable initial	30	467.71	82.25	15.01		
Stable final	30	469.46	82.54	15.07	-1.703	0.099
Unstable initial	30	372.60	76.82	14.02		
Unstable final	30	371.55	76.80	13.10	0.592	0.558
Force 65%						
Stable initial	30	505.58	92.10	16.81		
Stable final	30	503.81	96.73	17.66	0.881	0.385
Unstable initial	30	405.37	81.58	14.89		
Unstable final	30	404.24	77.01	14.06	0.657	0.516

Final strength values presented in Tables 2, show slightly deviation in regard to the initial measuring, regardless the type of surface and the external load used. This is not a surprise since by its level of resistance used the programme did not target the development of force. However, the force is taken as a representative parameter since a muscle is a unique functional unit, one of which characteristics is hard to be affected (as e.g. strength) without changing the other one, as e.g. force (Peric & Petrovic, 2015).

Muscular Strength

Table 3. Results of gained strength (W) with the 55%, 60% and 65% weight of 1RM

Strenght 55%	N	M	SD	SE	t	p
Stable initial	30	235.57	62.39	11.39		
Stable final	30	271.60**	50.98	9.30	-4.354	**0.000**
Unstable initial	30	220.04	59.90	10.93		
Unstable final	30	243.43**	54.22	9.90	-2.561	**0.016**
Strenght 60%						
Stable initial	30	258.67	54.89	10.02		
Stable final	30	283.03**	58.94	10.76	-4.530	**0.000**
Unstable initial	30	213.85	55.28	10.09		
Unstable final	30	230.14*	54.36	9.92	-2.477	**0.019**
Strenght 65%						
Stable initial	30	267.64	66.67	12.17		
Stable final	30	292.61**	74.18	13.54	-3.250	**0.003**
Unstable initial	30	211.51	53.97	9.85		
Unstable final	30	228.69**	66.42	12.12	-3.024	**0.005**

Analysing the final strength values presented in Table 3. using 55%, 60% and 65 % external load of 1RM, statistically significant increase in absolute strength between initial and final measurements was determined regardless the type of surface. Moreover, similar results (i.e. the strength and power increase) of Cowley et al. survey with untrained women (2007) were shown when doing the chest press, regardless the type of surface, while using the same or more than 85% external load of 1RM. Using Swiss ball in resistance training gave efficient results for a short period of time, which is recommended to be used in untrained women training.

By expressing the corrected mean power of force or covariance, the real difference in progress was verified for both groups (Table 4).

Table 4. Results of gained strength (W) with the 55%, 60% and 65% weight of 1RM

Strenght 55%	N	M	SD	t	p	Mkor	F	p
Stable surfaces	30	235.57	62.39			267.21		
Unstable surfaces	30	220.04	59.01	0.98	0.329	247.83	0.346	0.68
Strenght 60%								
Stable surfaces	30	258.67	54.89			267.37		
Unstable surfaces	30	213.85**	55.28	3.15	**0.003**	248.80	3.909	0.053
Strenght 65%								
Stable surfaces	30	267.64	66.67			264.89		
Unstable surfaces	30	211.51**	53.97	3.58	**0.001**	256.41	0.634	0.429

Testing the corrected mean strength, i.e. covariance in both groups of examinees, the real contrast in progress was examined, which refer to the efficiency of the resistance training using unstable and stable surface. The results (Table 4) show that the increase of strength expressed in absolute means with groups of examinees was equal regardless of the type of surface or output load (55%, 60% and 65% of 1RM). These results confirm Goodman et al. survey (2008), which does not support the idea that resistance training using unstable surface is more efficient when it comes to increasing the strength parameters in contrast with traditional type of training using stable surface.

Table 5. Results of relative strength (W) with the 55%, 6 % and 65% weight of 1RM

Strenght 55%	N	M	SD	SE	Mdiff	t	p
Stable initial	30	2.79	0.67	0.12			
Stable final	30	3.21**	0.48	0.08	-0.42	-4.347	**0.000**
Unstable initial	30	2.70	0.72	0.13			
Unstable final	30	3.00*	0.68	0.12	-0.29	-2.549	**0.016**
Strenght 60%							
Stable initial	30	3.08	0.61	0.11			
Stable final	30	3.40**	0.68	0.12	-0.32	-4.696	**0.000**
Unstable initial	30	2.62	0.60	0.11			
Unstable final	30	2.82*	0.61	0.11	-0.20	-2.515	**0.018**
Strenght 65%							
Stable initial	30	3.19	0.82	0.15			
Stable final	30	3.48**	0.96	0.17	-0.29	-3.089	**0.004**
Unstable initial	30	2.59	0.59	0.10			
Unstable final	30	2.79**	0.73	0.13	-0.20	-2.802	**0.009**

Based on the results attained, regarding the arms and shoulders muscular strength using external output load 55%, 60% i 65% of 1RM (Table 5), it can be concluded that the resistance training applied had a significant influence on the level of relative arm and shoulders' strength with both groups of examinees regardless the type of surface in increasing ones strength in regard to their body mass.

T – test for independent samples was used to compare the results of relative strength with 55%, 60% and 65% load of 1RM between the group of examinees who had been training on stable surface and the group of examinees who had been training on unstable surface (Table 6).

Table 6. Results of relative strength (W) with the 55%, 60% and 65% weight of 1RM (covariance analyse)

Strenght 55%	N	M	SD	t	p	Mkor	F	p
Stable surfaces	30	2.79	0.67			3.19		
Unstable surfaces	30	2.70	0.72	0.457	0.649	3.02	1.953	0.168
Strenght 60%								
Stable surfaces	30	3.07	0.61			3.20		
Unstable surfaces	30	2.62	0.60	2.877	**0.006**	3.01	3.030	0.087
Strenght 65%								
Stable surfaces	30	3.19	0.82			3.18		
Unstable surfaces	30	2.59**	0.59	3.226	**0.002**	3.10	0.401	0.529

Statistically significant difference has not been defined with the output load 55% of 1RM. Covariance analyse was used to compare the efficiency of the two different types of resistance training programmes on raising the level of relative strength. After correcting the results of the final relative strength measuring (Table 6), according to the initial measuring results, statistically significant difference between these two groups of examinees was not defined at the final measuring of relative strength (F = 1.953, p = 0.168). The increase of relative strength was equal with both groups, one of which used stable surface in their training and the other used the unstable surface.

T - test for independent samples was used to compare the initial results of relative strength with 60% output load of 1RM between the group that used stable surface in their training and the group that used the unstable surface in their training (Table 6). Statistically significant difference in level of relative strength in the initial measuring has been defined between the examinees of the first group who had done the resistance training programme using stable surface (M = 3.07, SD = 0.61) and the group of examinees who had done the resistance training programme using unstable surface (M = 2.62**, SD = 0.60, t = 2.877, **p = 0.006**). After correcting the results of the final relative strength measuring, according to the initial measuring results, statistically significant difference between these two groups of examinees was not defined at the final measuring of relative strength (F= 3.030, p = 0.087). Corrected arithmetic mean (M = 3.20) of the group of examinees who had done the resistance training programme using stable surface was not statistically much bigger than corrected arithmetic mean (M = 3.01) of the group of examinees who had done the resistance training programme using unstable surface (Table 6). The final measuring results confirm that the increase of the relevant strength was equal both with the group that had trained using stable surface, as well as with the group that had trained using unstable surface with the output load 60% of 1RM.

Table 6., presents statistically significant difference in levels of relative strength with the output load 65% of 1RM between the group of examinees who had done the resistance training programme using unstable surface (M = 3.19, SD = 0.82) and the group of examinees who had done the resistance training programme using stable surface (M = 2.59**, SD = 0.59, t = 3.226, **p = 0.002**). After correcting the results of the final relative strength measuring, according to the initial measuring results, statistically significant difference between these two groups of examinees was not defined at the final measuring of relative strength (F = 0.401, p = 0.529), which means that increase of relative strength was equal with both groups.

Discussion

Designing a training programmes is a very complex work to do and a resistance training is surely one of the most demanding ones, regardless of the type of surface used (stable or unstable). Following the methodology references, an eight-week training programme has been designed with the clearly defined external load which is being used during the training programme (50% of 1 RM), number of repetitions, breaks between the series and the time limit required for its realisation. Some studies have shown that maximum strength output results were accomplished when using the load between 30-50% of 1RM. The others have shown that maximum strength output results were when using the load between 40-60% of 1RM, while Baker et al. recommend 65% of 1RM (2003).

Regardless the doubts on the maximum strength output that are still present even today, the output load used during testing both groups of examinees were 55%, 60% and 65% of 1RM. These loads guarantied the technically correct exercise performance using „flat bench press“ and the examines' safety at the same time, bearing in mind that the examinees were untrained people who haven't done any training programmes before.

The increase of muscular parameters, therefore strength, regardless of the type of surface or output load, proves the efficiency of resistance training using unstable surfaces with untrained male individuals, which assert the Mate – Munoza et al. study results (2014) on the efficiency of resistance training using unstable surfaces to improve the lower and upper limbs muscle parameters with untrained men. The results of the eight-week training programme prove the Marinkovic et al. survey (2011) on chest press using external load 50% of 1RM stimulating the increase of muscle function parameters, as well as increasing the muscle straight with previously untrained individuals to the great extent.

Certainly, this resistance training programme using unstable surface- Swiss ball deserves to be the part of the training activities designed for untrained men and stimulates sufficiently the increase of strength. Panze et al. survey (2014), Zemkova et al. survey (2010) which confirm the increase of the energy exhaust during bench press using unstable surface, additionally motivate the author and inspire for some forthcoming research works in this field, especially in creating a concept for a resistance training programme using unstable surface for regulating body fat or fat loss. The results of this research have shown the success of a specifically and individually designed resistance training programme and justified this way of working with non-sports people, i.e. with untrained people who have not yet had an organized and scheduled exercise system. Besides, the usage of modern equipment in training results quantification, as e.g. FytroDyne Premium, gives no space to trainers to assess freely the progress of an individual and enforces this kind of practice as a standard for working with sportspeople, as well as with untrained people and amateurs.

Conclusion

Based on the results of absolute values of force, it can be concluded that the eight - week training programme for untrained male individuals using an external load 50% of 1RM, does not increase absolute values of force regardless of the type of surface (flat bench or Swiss ball) or the external load.

Unlikely the attained values of the absolute force, based on the results of the absolute force values, it can be concluded that the eight - week training programme, using an external load of 50% of 1RM, increases equally absolute values of strenght regardless of the type of surface (flat bench or Swiss ball) or the external load. Also, according to the attained results of the relative strength values, it can be concluded that eight-week training programme using external load 50% of 1RM by untrained men equally leads to relative strength values increase regardless the type of surface used (flat bench and Swiss ball) or output load.

Conflict of Interest, The authors declare that there is no conflict of interest.

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