

Original Article (short paper)

Comparison of the effects of different physical activities on laterality and asymmetry values through side bridge test

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Abstract — Aim: To compare the effects of different physical activities on laterality and asymmetry values through the side bridge test. **Methods:** the assessments were carried out in 45 subjects between 18 and 30 years old, 15 Crossfit-trained individuals, 15 weight trained and 15 sedentary. The subjects performed the side bridge test on both sides. After checking the normality and homogeneity of the data, we selected the appropriate statistical analysis for the comparison of the variables, adopting a significance level of $\alpha < 0.05$. **Results:** there was no statistical difference in the balance ratio; however, significant difference was found in the side bridge test endurance time, in which the Crossfit group obtained longer times on both sides than the other two groups. The side bridge test is a test of simple execution and that in this study the Crossfit group presented better results in the endurance time in the side bridge test. **Conclusion:** the results of the ratio asymmetry and endurance time are not sufficient to evaluate the resistance of the core muscles but could be an evaluation tool, the side bridge test can be introduced in postural training programs.

Keywords: core; weight training; Crossfit; sedentary; ratio.

Introduction

According to the American College of Sports Medicine¹, one of the most studied types of physical training is the core training, which focuses on the musculoskeletal structure that includes the spine, hip, pelvis and the proximal portion of the lower limbs and works in conjunction with the spine providing stabilization to perform functional movements². Within this muscular complex, a major importance is given to the abdominal and paravertebral muscles, which have been shown to be essential to maintain the stability of the spine in different circumstances and act in the prevention of injuries in daily and sports activities. Therefore, core training would be of the utmost importance, either for healthy individuals or for those who need rehabilitation². Several training methods comprise exercises aimed to activate the core – traditional ones, such as weight training; dynamic ones, with the using apparatuses (bench press or extensor chair, for example); stability exercises, with small amplitude and low load; and free weight exercises, without external load (free squatting, for example), used in functional trainings³, which has been proven the most efficient to minimize low back pain and improve functionality⁴. Crossfit[®] is currently the most widespread type of functional training.

Some tests measure core stability⁵ to obtain normative parameters for healthy individuals. One of the methods used to assess muscular endurance consists of the measurement of the isometric contraction time of the core muscles⁶, called side

bridge test⁷. McGill, Childs, Liebenson⁸ suggest the side bridge test to evaluate or test the musculature of the anterior and lateral trunk wall. The test is performed bilaterally, and muscle balance is compared by assessing contraction time. This procedure contributes to the analysis of laterality imbalance, reported in the literature as an important indicator of the causes of low back pain⁷.

Parallel position of the core muscles allows the generation of large compression forces, stabilizing the spine^{6,8}. Besides the active muscular force, intra-abdominal pressure may contribute to the stability of the vertebral spine⁹ through internal and external oblique muscles and transverse abdominal muscles¹⁰. Therefore, these structures are of the utmost importance for postural stability. The greater the asymmetries or alterations in muscle activation, the greater the chances of low back pain episodes⁸. McGill, Grenier, Kavcic, Cholewicki¹¹ predicate that the larger the difference between the time of resistance of the lateral flexors (right and left), more chances of problems in this region. Furthermore, McGill, Grenier, Kavcic, Cholewicki¹¹ proposed that resistance times on the side bridge test should be interpreted using the ratio of the endurance times of the non-dominant and dominant side. According to the formula proposed by Carabello, Reid, Clark, Phillips, Fielding¹², the asymmetry ratio should be as low as possible in order to avoid back pain. Regarding the laterality difference, Evans, Refshauge, Adams, Aliprandi⁷ found that athletes who presented a difference of more than

12 seconds between the sides presented incidences of low back pain. The hypothesis of this study is that, through the side bridge test, it could be verified that active individuals showed better results in the asymmetry ratio, better muscle balance, and better performances as well. Therefore, the aim of this study is to compare the effect of different physical activities on the symmetry between the non-dominant and dominant sides. Further, we evaluated the laterality values between times using the side bridge test during the test.

Methods

Experimental Approach

A cross-sectional study was carried out and dependent variables of the core muscles were obtained through the side bridge test: endurance time, asymmetry ratio and laterality difference. The n sample was based on previous studies^{13,14,15}. In addition, n was for convenience, due to the inclusion criteria and the available population that performed Crossfit®. Height and weight were used for descriptive purposes.

Subjects

This study enrolled 45 male and female participants, aged between 18 and 30, divided into three groups: weight training group (WTG), with 15 individuals with mean weight and height of 75.75 ± 16.00 kg and 1.72 ± 0.09 m respectively; Crossfit group (CFG), with 15 individuals with mean weight and height of 71.15 ± 12.54 kg and 1.71 ± 0.10 m respectively (these individuals practice Crossfit in the Crossfit Rio Claro, which is an official Crossfit affiliate); and sedentary group (SG), with 15 individuals of mean weight and height of 74.19 ± 16.45 kg and 1.74 ± 0.06 m, respectively. As inclusion criteria for WTG and CFG, participants should have practiced the modality for at least six months, not less than twice a week. The SG group comprised individuals who had not performed regular activities for at least six months. Exclusion criteria were the presence of pain or discomfort at the time of the test. Subjects were informed about the benefits and possible risks before signing an informed consent document approved by the institution to participate of this study. This study was approved by the Ethics and Research Committee (1.537.805)

Procedures

The side bridge test consists of maintaining the position as long as possible. In this study, a mat and a timer were used, and the test was performed on both sides with a 5-minute rest interval between them. Prior to testing, the participants received instructions on how to perform the movements.

The test was interrupted when the volunteer could not maintain the position and the hip touched the ground¹³. For laterality difference, we followed the one established by

Evans⁷, in which the endurance time difference between sides in seconds was obtained, and for reason analysis, we used the asymmetry formula proposed by Carabello, Reid, Clark, Phillips, Fielding¹² (Equation A). Participants did not receive any information or results prior to the conclusion of the study to avoid any influence during the test. All assessment data were collected in the Laboratory of Biomechanics of the Institute of Biosciences of the State University of São Paulo – Rio Claro / SP

$$\text{asymmetry} = \frac{|\text{weak side value} - \text{strong side value}|}{\text{strong side value}} \times 100\%$$

EQ. A. Asymmetry formula for ratio calculation, according to Carabello, Reid, Clark, Phillips, Fielding¹².

Statistical Analysis

Lilliefors test was used to verify data normality and homogeneity, the appropriate statistical analysis for the comparison between the groups was selected, adopting a significance level of $\alpha < 0.05$. Mann-Whitney test was used for the comparison between the dominant and non-dominant sides of the SG, while Student's t-test was used for the groups WTG and CFG. Anova One-Way was used to compare the ratio values between groups, and Kruskal-Wallis test was used to compare the difference between the sides among the three groups. Dominant and non-dominant side were compared using Anova One-Way with Bonferroni post-hoc.

Results

A significant difference was found when comparing the results of the dominant side between the groups ($P = 0.0001$): WTG presented 79.01 ± 19.71 seconds, CFG 114.02 ± 42.13 seconds and SG 50.66 ± 33.99 seconds. In this comparison, the CFG presented significantly longer endurance time for the dominant side (Figure 1). The same behavior occurred for the non-dominant side for all groups ($P = 0.0002$): WTG showed 81.07 ± 20.46 seconds, CFG 117.46 ± 45.31 seconds and SG 50.73 ± 30.72 seconds (Figure 2).

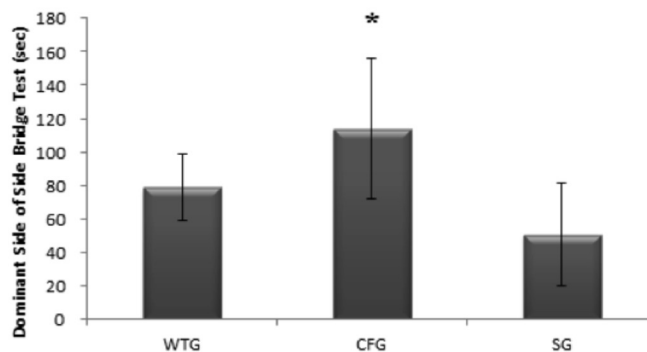


Figure 1. Mean and standard deviation of the of the side bridge test endurance time regarding the dominant side.

Legend: * $p = 0.0001$ regarding groups WTG and SG; WTG: weight training group; CFG: crossfit group; SG: sedentary group

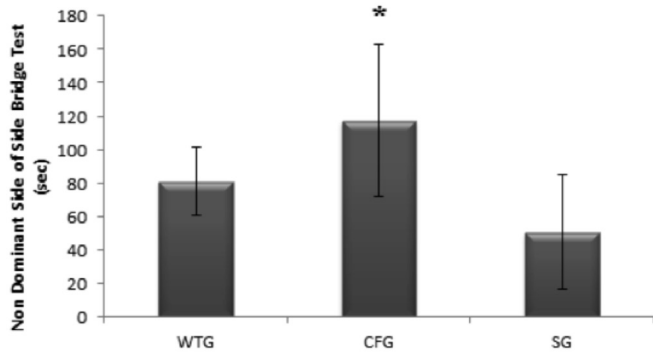


Figure 2. Mean and standard deviation of the side bridge test endurance time regarding the non-dominant side.

Legend: * p = 0.0002 regarding groups WTG and SG; WTG: weight training group; CFG: crossfit group; SG: sedentary group

No significant difference was found comparing the side bridge test maintenance time between the dominant and non-dominant sides in all groups (Table 1).

Table 1. Mean values and standard deviation of the weight training, crossfit and sedentary groups, dominant and non-dominant side bridge test endurance time (in seconds).

	Side Bridge Test Endurance Time (sec)		P
	Dominant Side (sec)	Non Dominant Side (sec)	
	Mean (±SD)	Mean (±SD)	
WTG	79.00(±19.70)	81.10/±20.45	0.7208
CFG	114.00/±42.15	117.45/±45.30	0.8298
SG	50.65/±34.00	50.75/±30.70	0.3186

WTG: weight training group; CFG: crossfit group; SG: sedentary group

The asymmetry ratio means are shown in Table 2 and the time difference variable between the non-dominant and dominant sides are presented in Table 3. No significant statistical difference was found when comparing the ratio between all the groups, nor for the difference between the sides.

Table 2. Mean values and standard deviation of the groups in asymmetry ratio.

	Asymmetry Ratio (sec)		P
	Ratio (sec)		
	Mean (±SD)		
WTG	14.35	±11.10	0.9188
CFG	16.35	±13.70	
SG	19.65	±11.80	

WTG: weight training group; CFG: crossfit group; SG: sedentary group

Table 3. Mean values and standard deviation of the groups considering the difference between the non-dominant and dominant sides.

	Difference Between Sides (sec)		P
	Difference Between Sides (sec)		
	Mean (±SD)		
WTG	14.20	±14.40	0.3976
CFG	20.95	±19.35	
SG	10.80	±10.65	

WTG: weight training group; CFG: crossfit group; SG: sedentary group

Discussion

The results showed that the side bridge test endurance time was significantly longer in the Crossfit group, both for the dominant and non-dominant sides, in comparison with weight training and sedentary groups. The long endurance time presented by the CF group can be associated with the fact that this modality comprises functional exercises that work the core muscles, once it provides more trunk instability¹⁶. Studies have reported that unstable exercises are efficient to train trunk musculature¹⁷; moreover, Kibler, Press, Sciascia¹⁷ stated that the training of this muscle group in high intensity, requires even more muscular activation in this complex. This can also be related to the abilities that Crossfit seeks to work on, such as strength, endurance, flexibility, and balance, as well as characteristics of training power and speed, which may also be related to this significance¹⁸. These components, according to Waldhelm and Li¹⁹, are also responsible for core stability.

When the endurance time data of each group were analyzed, there was no significant difference between the sides in any group, i.e., all groups obtained similar values on both sides. Thus, the results showed that, despite presenting shorter endurance time in comparison with WTG and CFG, the SG had higher levels of muscular balance. Therefore, once the sedentary individuals do not practice any physical activity, their dominant side does not predominate over the non-dominant, which was demonstrated throughout the side bridge test. However, chances of low back pain should not be excluded, once the test alone would not be sufficient to detect low back pain predictors. Muscle weakness²⁰, physical inactivity, flexibility and obesity are closely related to low back pain episodes²¹.

Regarding the CFG, no significant difference was found between the sides, probably because this modality does not require side dominance to be performed, unlike most sports modalities, which depend on the dominant side of the athlete, even under training of the non-dominant side²².

Regarding the WTG, although weight training does not present unstable exercises, it comprises exercises for the core, in addition to some exercises that are not specific to this muscle but require stability for the execution, such as the curl and deadlift³. Moreover, the modality does not require the predominance of a dominant side. Weight training is composed of resistance exercises that develop muscle strength and flexibility, favor good posture and better mechanical efficiency in basic movements²³. Body movements are results of the action of muscle groups, and for these muscle groups to remain in balance, any imbalance is compensated by muscle spasms, adjusting the body posture²⁴. Strength training is an important factor in improving postural parallel position since muscle strengthening and stretching maintains bone structures in the ideal pattern of balance, preventing back pain, postural hernia, and others²³.

In this study, the groups presented very close ratios, indicating symmetry between the sides and consequent balance. Low ratios do not correspond to higher endurance time in the side bridge test, as is the case of the sedentary subjects. The asymmetry ratio variable indicates balance, and not muscular endurance, once the sedentary group had shorter endurance times with

good balance results, while the Crossfit group showed the same balance with the longest endurance time in comparison with the other two groups.

Studies have reported that results of the muscular balance are important, therefore judging according to the ratios, seems a more reliable method to decide a good core stability status²⁵. The side bridge test assesses primarily the lateral core muscles. Juker, McGILL, Kropf, Steffen²⁶ investigated this test with myoelectric equipment and reported it as the most effective way to assess and train the abdominal obliques with little psoas activity. The side bridge test has high intrarater reliability and has been suggested in the literature as an appropriate method to test lateral trunk muscle endurance in clinical environments²⁵.

Furthermore, the literature reports that an acute bout of core stabilization exercise does not immediately alter trunk awareness or seated balance ability in any significant way, at least in healthy young populations²⁷; therefore, in order to work this musculature to reach the ideal ratio, some core training would be necessary, and side bridge test performed once is only related to the evaluation of the involved muscles.

In this study, the groups did not show significant statistical difference regarding laterality differences (ND-D). Evans, Refshauge, Adams, Aliprandi⁷ reported that athletes who present this difference greater than 12 seconds have greater chances of presenting low back pain. Although groups WTG and CFG presented values above 12 seconds, indicating that one side has greater resistance than the other, this may be indicative of possible episodes of low back pain, as well as an asymmetry between the sides of the trunk. For SG, this value of laterality difference was below 12 seconds, but as already mentioned herein, although the values are within appropriate levels, other factors can affect the stability of the core, such as muscle weakness, for example.

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