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RELATIONSHIP BETWEEN LEG DOMINANCE TESTS AND TYPE OF TASK

Jessica Velotta, Josh Weyer, Amanda Ramirez, Jamila Winstead and Rafael Bahamonde

Biomechanics Laboratory, School of Physical Education, Indiana University Purdue University Indianapolis, USA

The purpose of this study was to determine the relationships between common leg dominance tests and the type of tasks performed. Twenty-two subjects performed 4 manipulative and 2 standing balance tests. Leg preference was determined for each of the tests. Kendal tau correlations were used to establish the relationships between the tests. Significant correlations were found between the manipulative types of tests whereas the majority of the subjects used the right leg as the preferred leg. There were significant correlations between the two balance tests but little or no correlation between the balance and manipulative tests. This finding was the result of more than 50% of the subjects switching the preferred leg during the balance tests. Leg preference maybe an adaptation that depends on the nature of the tests required to perform.

KEY WORDS: leg dominance, tests, balance.

INTRODUCTION: Most people have a good understanding of what is meant to be right-handed; a right-handed person has increase mobility and strength with the preferred hand. However the notion of foot or leg dominance may not be as obvious and it might require to be viewed in a different perspective considering the roles of the legs in different tasks such mobility and stability. A leg can be used to manipulate an object such as a soccer ball whereas the other foot has an important role of postural control and stability. Most researchers make the assumption that the dominant leg is the preferred leg and the non-dominant leg is the non-preferred limb. This assumption might be correct for tasks requiring mobility but for more unilateral tasks or task requiring balance and/or stability such as one single leg hopping or even standing balance it might questionable. Several studies (Gentry & Gabbard, 1995; Spry et al., 1993; Whittington and Richards, 1987) support the notion that humans are generally right-footed for mobilization tasks but left-footed for tasks requiring postural stabilization. Spry et al. (1993) determined that the dominant leg in right or left leg dominant subjects as determined by a series of manipulative and weight-bearing performance tests was not the stronger of the two legs using isokinetic testing and the preference of leg by either right or left leg dominant subjects was dependent on the type of activity, manipulative or weight-bearing. Although there might be more neurological demands with the dominant leg (manipulative), according to Previc's theory, the fact that the antigravity extension control on the left side of the body emerge before the voluntary control on the contralateral side tends to support the notion of left side dominance (Previc, 1991). The concept of leg dominance is important in clinical settings. Clinicians often use isokinetic strength exercises and single leg hop test in lower extremity rehabilitation; these test scores are used as criterion to determine the progression and the suitability of the patient to return to sport participation. It has been suggested (Shelbourne et al., 1995), that once the anterior cruciate ligament (ACL) reconstructed extremity achieves 70% of the strength of the non-injured leg, the patient may be allowed to engage in sport-specific activities. Such criterion might be a valid standard assuming no strength differences exist between limbs prior to injury which might be dependent on leg dominance. Therefore the purposes of this study are to evaluate the relationship between clinical tests used determine leg dominance and tests requiring postural control. Our hypotheses are that there will be little or no relationship between these tests and leg preference is an adaptation that depends on the nature of the tests.

METHODS: Twenty two healthy college-age (21.5 ± 1.9 years) subjects (nine males and 13 females) with no lower extremity problems were recruited to participate in the study. The subjects had an average height of 172.7 ± 10.6 cm and an average weight of 78.1 ± 13.1 kg. Informed consent was obtained upon arrival to the laboratory. The subject's height was collected using a stadiometer and the weight was measure using an AMTI force platform (AMTI, Watertown, MA). Each subject was asked to perform four manipulative tests commonly used to determine leg dominance and two balance tests with whatever leg they preferred. In the manipulative tests the subjects were asked to kick a ball, step on bug, write a word with the foot, and take a step forward. For the two balance tests, the subjects were asked to stand on one leg and to stand still on two AMTI force platforms for period of 100 seconds. Three trials of the two leg standing tests were recorded at 50 Hz. Vertical ground reaction forces were collected and the average force over the 100 second period was computed to determine which the preferred leg was. A symmetrical index (SI) similar to the one used by Robinson et al., (1987) using the average vertical ground reaction force (expressed as percentage of body weight) for each leg was used to calculate the difference between the two legs. A positive SI indicated that the subject preferred the right leg and a negative SI a left leg preference. Data from all the tests were coded into numeric values where right equal zero and left equal one.

$$SI = \left(F_{VR} - F_{VL}\right) \Big/ \left(F_{VR} + F_{VL}\right) * 100$$

Non-parametric statistics were used to determine the relationships between the tests. The Kendall tau rank correlation coefficient was used to measure the degree of correspondence between two rankings and assessing the significance of this correspondence.

RESULTS: The proportions of leg preferences for each test are presented in Table 1. Table 2 shows the Kendal Tau correlations between the tests.

Table 1
Percentages of Leg Preferences

Test N=22	Right Leg Preference %	Left Leg Preference %
Kick	90	10
Step on Bug	80	20
Write Word	90	10
Step Forward	90	10
One Leg Standing	40	60
Two Leg Standing	50	50

Table 2
Kendal Tau Correlations

	Kick	Step	Write	Step F	One Leg	Two Leg
Kick	1.0	0.67*	0.45*	0.45*	-0.09	0.0
Step on Bug		1.0	0.67*	0.67**	0.11	0.0
Write Word			1.0	1.0*	0.24	0.32
Step Forward				1.0	0.24	0.32
One Leg Standing					1.0	0.57**
Two Leg Standing						1.0

Significant correlations *p<.05, ** p<.01

Eighty to 90% of the subjects chose the right leg when the test was manipulative in nature but when asked to perform one of the two balance and stability tests, more than half of the subjects switched legs to the left. The manipulative tests were significantly correlated but poorly or not correlated with the balance and stability tests. Figure 1 shows the results of the

SI for the two legs standing test. Half of the subjects preferred to use the right leg (8 ± .6.6 %BW) and the other 50% preferred to use the left leg (5 ± 2.3 %BW). In most subjects there was a clear preferred leg; one leg generated greater vertical forces during the entire 100 seconds trial (see Figure 2).

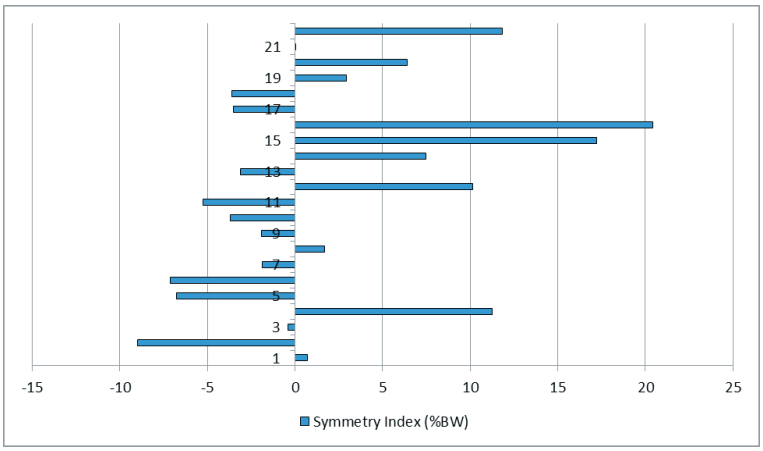

Figure 1: Symmetry index from standing test expressed as %BW.

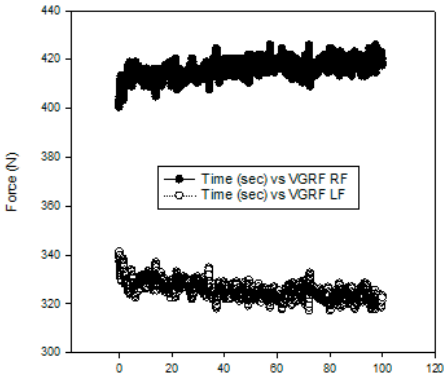

Figure 2: Two leg standing test

DISCUSSION: The concept of limb dominance is based on the premise that the two hemispheres of the brain function differently and there is some preferential use of one limb for activities under voluntary control. However, lower limb dominance may be associated with the task require to do. Peter (1988) defined the lower limb use in terms of preferred and non-preferred depending on the task require (i.e. manipulate an object or jumping). Several studies has supported the notions that humans are typically right dominant for activities requiring mobilization and left dominant for activities require postural stabilization and strength (Gentry & Gabbard, 1995; Spry et al., 1993; Whittington and Richards, 1987; Chow et al., 2005). Research studies often determine leg dominance based on which leg the subject kicks a ball (English et al, 2006; Petschnig, et al., 1998; Greenberg & Paterno, 1995; Brophy et al., 2010). Brophy et al., (2010) suggested that the limb dominance might be factor in the etiology of ACL injuries since females were more likely to injure their non-dominant leg or supporting leg. In addition, clinician often use the scores of multiple lower extremity test and compare the injured with the non-injured leg without taking in consideration leg dominance.

The results our study suggests that limb dominance is related to the type of task the subject is asked to perform. If the task required is manipulative in nature, the majority of the subjects, 80-90% will rely on the right leg as the preferred or dominant leg. But, when the subjects are asked to performed a task requiring whole body stabilization, there is switch towards the left leg (see Table 1). Sadeghi et al., (2000) suggested a possible explanation for this change in preferred leg, during stabilization tasks the opposite leg is used for dynamic counter-balance and since the right leg is better at manipulative activities, the left leg is used for stabilization. It is clear that the manipulative tests used in this study detect the dominant leg for those tasks but for tests involving jumping, standing or landing researchers should use a test specific to detect the preferred leg during weight bearing activities.

CONCLUSION: Leg dominance seems to be function of the type of activity a subject is required to perform. When the task is manipulative in nature, most subjects will use the right leg (most people are right-side preference) but when the task involves stabilization such as standing on one leg, more that 50% of the subjects in the study use the left leg perform the task. Researcher should select the appropriate leg dominance test depending on the task being investigated. If the task investigated is manipulative in nature, leg dominance test should be the appropriate such as kicking a ball. But if the task analysed involves stabilization and postural control, the leg dominance require similar tasks and not a manipulative type of test. Further research will be helpful in understanding how leg dominance play a roles during power related activities.

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