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Original article

STUDY OF DYNAMIC POSTURAL CONTROL IN YOUNG ADULTS

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Abstract

Aim: Dynamic postural balance is important stability and movement ability of all people. Dynamic postural control has significant influence in sport and physical activities as well as in recovery of movement abilities after trauma. The purpose of the study is to evaluate the dynamic postural control in young healthy people. Hypothesis: There may be significant differences in dynamic postural control between males and female, resulting in lower limbs injuries.

Methods: Y Balance Test Lower Quarter (YTB LQ). This test was used to evaluate the dynamic postural balance of the subjects and to predict lower limb injuries. The subjects were 215 healthy, young people (males / females, active / sedentary), with ages between 18 and 29. The results were processed using the one-way ANOVA and the post ANOVA Critical Tukey HSD.

Results: The data provided values of dynamic equilibrium, in three directions and for each supporting leg (stance). The values were better in active versus sedentary males, in all directions measured and for each leg. The pattern of better results for active versus sedentary was also found in women. The hypothesis was partially confirmed. The results indicate symmetry of the dynamic postural control for the anterior plane in all subjects. For the medial-posterior plane there is symmetry in trained subjects. There is asymmetry in all subjects for the lateral-posterior plane. For the medial-posterior plane there is asymmetry only in the sedentary subjects.

Conclusions: The YB Test is a reliable method for assessing dynamic postural balance and injury prevention. Some actions on asymmetric directions may cause injury of the lower limbs.

Key words: dynamic postural balance, young people, Y Balance Test Lower Quarter

Introduction

Posture is a function of the human body based on synergistic and coordinated action of locomotors and nervous system. Stability is obtained by cooperation with the psychomotor system. Stability is maintained by the reflection body static posture (Pascan, 2003).

Body posture maintains stability, balance of body elements and balance of body and environment (Cordun, 1999). The skeleton structure's components are in exactly form as the report attitude or postures of the body. Body posture is influenced by three factors, as: heredity, pathological and habit.

Balance is the status of a body, under the influence of a force that maintains its ability to move whether it is static or dynamic condition (Albu&al, 2007).

Dynamic balance is an important component of motor skill development. Poor dynamic balance has previously been associated with sport related injury. Increased postural sway and falling are associated with aging and are likely related to problems with postural control in the elderly (Alexander & al., 1991).

Knowing how to achieve body balance is necessary for daily activities and sports events (Marcu, Matei, 2005).

The necessary condition to maintain balance is that the project of gravity center to be in support base.

The purpose of the study is to evaluate the dynamic postural control in young healthy people. Hypothesis: There may be significant differences in dynamic postural control between males and female, resulting in lower limbs injuries.

Methods

Y Balance Test Lower Quarter (YTB LQ). This test was used to evaluate the dynamic postural balance of the subjects and to predict lower limb injuries. The subjects were 215 healthy, young people (males / females, active / sedentary), with ages between 18 and 29. The males were 91 (46 active and 45 sedentary) and 124 females (59 active and 65 sedentary). The results were processed using the one-way ANOVA and the post ANOVA Critical Tukey HSD. The Y balance test (YBT) is a screen of dynamic balance requiring stance leg

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balance while the contralateral leg reaches in anterior (ANT), posteromedial (PM) and posterolateral (PL) directions. YBT has been proposed as a screen for injury risk; however, limited research has examined the association between YBT and injury (Smith, Chimera, Warren, 2015).

Results

YBT LQ - males for anterior reach

The intra group results for active males mean an average 74.40 cm for left leg and 73.37 cm for right leg. The coefficient of variation has a value that indicates a homogenous group for both stance legs balance of active males. The difference between the left and right leg is

1.03 cm (table 1). The intragroup review for sedentary males shows an average of 69.48 cm for left leg and 70.88 cm for right leg. Both of groups are homogeneous for this statistical parameter. The average's difference for sedentary group is 1.40 cm (table 1). Statistical analyze shows no significant difference between the values for anterior reach in left and right leg for both of the groups.

The intergroup review shows some differences: active males have better results for both legs, but the difference between active and sedentary left leg is 4.92 cm and the difference between same groups for right leg is smaller at 2.49 cm (table 1).

Table 1 YBT LQ for anterior reach males

Stance Leg	Parameters	Active Males N=46	Sedentary Males N=45	Dif active sedent
Left leg	M±DS(cm)	74.40±7.55	69.48±7.21	4.92
	Cv%	10.11	10.38	
Right leg	M± DS(cm)	73.37±4.94	70.88±7.33	2.49
	Cv%	9.05	10.34	
	p	<0.05	<0.05	
	P critic	5.13	6.53	
	F	1.33	1.72	
	Dif. M(cm)	1.03	1.40	
Balance		Symmetry	Symmetry	

1.YBT LQ - males for posteromedial reach

The results for active males indicate average values of 95.85 cm for left leg and 92.44 cm for right leg for active males. The average difference for active males on left and right leg is 3.71 cm. According to the coefficient of variation the results are homogeneous for left and right leg in posteromedial reach – active male. The average difference between right and left leg is 3.41 cm. The statistical analyze shows no significant difference at 95% confidence interval for stance leg balance between right and left leg.

The intragroup sedentary results show average of 94.73 cm on left leg and 91.02 cm on right leg. The results for left leg are homogeneous, but for right leg they look to be moderate variability (table 2).

We notice a close difference of active and sedentary males for left and right stance balance on left and right leg 1.12 cm versus 1.42 cm (table 2).

Table 2 YBT LQ for posteromedial reach males

Stance Leg	Parameters	Active Males N=46	Sedentary Males N=45	Dif active sedent
Left leg	M±DS(cm)	95.85±10.16	94.73±8.54	1.12
	Cv%	10.28	8.92	
Right leg	M±DS(cm)	92.44±13.63	91.02±13.90	1.42
	Cv%	14.75	15.27	
	p	<0.05	<0.05	
	P critic	5.13	6.53	
	F	4.71	6.40	
	Dif. M(cm)	3.41	3.71	



Balance

Symmetry

Symmetry

2.YBT LQ - males for posterolateral reach

The intra group results for poster lateral reach for active group indicate average about 92.12 cm for left leg and 98.40 cm for right leg. The average difference between right and left leg is 6.15 cm. Both of groups are homogeneous statistical according to variation coefficient with close values. For right leg the average is better than left leg. The statistical parameters show significant difference at 95% confidence interval on left and right leg for active group (table 3).

The intra group results for sedentary group of males the average values indicates 86.23 cm on left leg and 92.38 cm on right leg. The right leg values are strong homogeneous ($C_v = 10.46\%$) and around homogeneous for left leg. Statistical analyze shows significant differences between left and right leg on posterolateral reach, for <0.05 confidence interval (table 3).

The intergroup dates show a difference of 5.89 cm between active and sedentary males for posterolateral reach and 6.02 cm for same situation on right leg (table 3).

Table 3 YBT LQ for posterolateral reach males

Stance	Parameters	Active	Sedentary	Dif.
Leg		Males	Males	Active
Balance		N=46	N=45	sedentary
Left leg	M \pm DS(cm)	92.12 \pm 11.49	86.23 \pm 13.51	5.89
	Cv%	12.46	15.61	
Right leg	M \pm DS(cm)	98.40 \pm 11.62	92.38 \pm 9.87	6.02
	Cv%	11.53	10.46	
	p	<0.05	<0.05	
	P _{critic}	5.43	6.53	
	F	8.18	7.86	
	Dif. M(cm)	6.28	6.15	
Balance		Asymmetry	Asymmetry	

3.YBT LQ - females for anterior reach

The intra group results for active females indicate: average value for left leg is 68.10 cm and 68.69 cm for right leg. The coefficient of variation shows high homogeneity (9.27% and 8.42%). Statistical analyze indicates no significant difference between left and right leg in anterior reach. The average difference between left and right leg is small 0.59 cm (table 4).

The intra group date indicates 64.29 cm for let leg versus 66.03 cm right leg. The average difference is very small, namely 0.59 cm. The average difference between both legs is 1.74 cm. The statistical analyze shows no significant difference between left and right leg in anterior reach, for sedentary females (table 4).

The intergroup average difference is 3.81 cm for left leg active versus sedentary females and 2.66 cm for right leg (table 4).

Table 4 for YBT LQ for anterior reach females

Stance	Parameters	Active	Sedentary	Dif.
Leg		Females	Females	active
Balance		N=59	N=65	sedentary
Left leg	M \pm DS(cm)	68.10 \pm 6.31	64.29 \pm 4.96	3.81
	Cv%	9.27	7.72	
Right leg	M \pm DS(cm)	68.69 \pm 5.78	66.03 \pm 4.18	2.66
	Cv%	8.42	6.33	
	p	<0.05	<0.05	
	P _{critic}	4.53	4.10	
	F	0.47	1.32	



	Dif.M(cm)	0.59	1.74
Balance	Symmetry	Symmetry	Symmetry

4.YBT LQ - females for posteromedial reach

The into group data for poster medial reach at active females show an average of 84.16 cm for left leg and 86.32 cm for right leg. The average difference for stance legs balance is 2.16.cm. According to coefficient of variability there is a good homogeneity of both stance leg balance (11.13% and 10.77%). Statistical analyze indicate no significant difference of stance balance for left leg versus right leg at 95% confidence interval (table 5).

The into group analyze for sedentary group shows an average of 79.33 cm on left leg and 85.52 cm on right left. The average difference between stance legs balance is 6.19 cm. Coefficient of variability is 11.10% for the values of left leg and 8.40% for right leg that means a good homogeneity of both group. There is a significant difference of the values between the stance legs balance, indicated by statistical analyze (table 5).

The intergroup difference is 4.83 cm between active and sedentary females for left leg and 0.80 cm for right leg (table 5).

Table 5 YBT LQ for poster medial reach females

Stance Leg Balance	Parameters	Active Females N=59	Sedentary Females N=65	Dif. active sedent
Left leg	M±DS(cm)	84.16± 9.37	79.33±8.81	4.83
	Cv%	11.13	11.10	
Right leg	M±DS(cm)	86.32± 9.29	85.52±7.19	0.80
	Cv%	10.77	8.40	
	p	<0.05	<0.05	
	P _{critic}	4.53	4.10	
	F	2.15	6.13	
	Dif.M(cm)	2.16	6.19	
Balance		Symmetry	Asymmetry	

5.YBT LQ - females for poster lateral reach

The into group analyze for poster lateral YBT indicates an average of 82.10 cm for stance balance for left leg and 88.52 cm for right leg. The average difference of balance is 6.42 cm. Both groups of results are homogeneous according to the variability coefficient of 11.13% and 10.77%. There is a significant difference in stance balance on left versus right leg (table 6).

For the group of sedentary group the YBT average on left leg is 80.58 cm and 87.86 cm on right leg. The

difference between the stance leg balances is 7.28 cm. The coefficient of variability indicates homogeneity in both stance balance legs values. According to statistical analyze there is a significant difference in stance balance on left versus right leg (table 6).

The YBT difference for active and sedentary females on left leg is 1.52 cm and 0.66 for right leg (table 6).

Table 6 YBT LQ for poster lateral reach females

Stance Leg Balance	Parameters	Active Females N=59	Sedentary Females N=65	Dif. active sedent
Left leg	M±DS(cm)	82.10± 9.90	80.58±11.72	1.52
	Cv%	11.97	14.55	
Right leg	M±DS(cm)	88.52± 8.07	87.86±7.19	0.66



Cv%	9.12	9.00
p	<0.05	<0.05
P _{critic}	4.53	4.10
F	5.86	6.27
Dif.M(cm)	6.42	7.28
Balance	Asymmetry	Asymmetry

Discussions

The cutoff for asymmetry is 4 cm, so anyone with 4 or above is deemed asymmetrical. Stance leg balance while the contralateral leg reaches asymmetry >4 cm was associated with increased risk of noncontact injury (Smith et al., 2015).

Dynamic postural balance analyzed by YBT for males indicates different issues. There is symmetry in stance leg balance for anterior reach (ANT). A comparison of male soccer players at high school, college, and professional levels found the greatest anterior reach distances in the high school athletes—contrary to the authors' hypothesis that a higher level of competition would correlate with better performance (Smith & Warren, 2014).

The difference of stance legs balance is about 1 cm for active and sedentary males. The same situation is for stance leg balance with a difference of 3.41 for active and 3.71 for sedentary males on posteromedial reach (PM) that indicate symmetry. The situation is different for posterolateral reach (PL) with values greater than 4 cm. We found 6.28 cm for active males and 6.15 cm for sedentary males. So we can say that there is some asymmetry for both groups of subjects.

According to the norm that admits more than 4 cm as asymmetry, for some subjects there is an increased risk of injury. We emphasize the risk on stance leg balance the contralateral leg in posterolateral reach for active and sedentary males (5.89 cm and 6.02 cm). So dynamic postural balance is better for active and sedentary males in anterior reach, a little bit of carefulness is required in posterolateral reach and greater carefulness for posterolateral reach.

Dynamic postural balance analyzed by YBT for females indicates more asymmetry than males. It is symmetry in stance leg balance for anterior reach for active and sedentary females indicated by ANT value (0.59 cm/active and 1.74 cm/sedentary subjects). On posteromedial reach there is symmetry for active females (2.16 cm at PM) and asymmetry for sedentary subjects (6.19 cm at PM). Both groups of females have

asymmetry on posterolateral reach: 6.42 cm for active and 7.28 cm for sedentary (PL).

It can be said that the group of sedentary females has a greater risk of injury in posteromedial and posterolateral reach, while the active females has this risk only in posterolateral reach.

Bouillon & Baker (2011) found Lower postural control scores based on the Star Excursion Balance Test were found for the older women. The younger women were able to reach approximately 7 cm farther during the anterior and posteromedial excursions.

Gorman et al. findings indicate that there is no difference in the YBT-LQ performance in athletes who compete in one sport compared to athletes who compete in multiple sports. In addition, male exhibit increased performance on the YBT-LQ compared to females even when values are normalized to leg length. No significant interactions or main effects related to number of sports played were observed for any YBT-LQ score ($p>0.05$). Male athletes exhibited significantly greater normalized reach values for the posteromedial, posterolateral, and composite reach while also exhibiting a larger anterior reach difference when compared to the females. Athletes who participated in multiple sports had similar performances on the YBT-LQ when compared to athletes who participated in a single sport (Gorman et al. 2012).

Butler (2013) suggests that normative values for dynamic balance may be influenced by country of origin in addition to the previously established covariates of gender, sport, and competition level. Additional research needs to be conducted in order to identify if dynamic balance has a similar association with non-contact injuries in other cultures/countries. However, it may be appropriate to reconsider what the traditional United States definition of normal performance on the YBT-LQ is and how this could influence what are considered to be dynamic balance standards.

Age may influence performance in a bell curve, with improved performance over time until individuals are aged 30 years, when a decrease in reach distance is seen. More research is needed in differently aged populations to support this trend (Smith & Warren, 2014).



Conclusions

For all males asymmetry in reach distance between limbs has been reported for posterolateral reach directions. For females asymmetry in reach distance between limbs has been reported for posterolateral (all subjects) and posteromedial (sedentary subjects) reach directions. We found asymmetry in all males and females for posterolateral direction, as result from restriction in full extension of the stride leg as well as closed chain ankle dorsiflexion and hip internal rotation mobility restrictions of the stance leg.

There is asymmetry for sedentary females on poster medial reach, that could mean a risk of injury due to the due to poor multiplanar control of the stance hip and a lack of core stability.

Butler et al that composite score below 89.6% increased risk of noncontact lower extremity injury by 3.5 times (95% CI, 2.4-5.3) in a collegiate football cohort; however, they found no relationship between reach asymmetry and injury risk. In contrast, Smith et al found no relationship between composite score and injury risk, while anterior reach asymmetry greater than 4 cm increased the odds of injury by 2.2 (95% CI, 1.1-4.5).

In this study males performed greater reach values for all direction. The greatest performance for males was in posteromedial reach and in posterolateral for females.

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