15 - LATERAL DIFFERENCES OF MUSCULAR STRENGTH OF SOCCER AND BASKETBALL PLAYERS

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Introduction

Functional asymmetry of lower limbs may be caused by differences in motor ability especially strength and coordination [1]. Muscular asymmetry between the right and left leg can lead to mechanical overload and compensatory mechanisms which change movement and posture [1,2]. Consequences of these lateral differences of the lower limbs are higher injury risks and restrictions of sport performance. Therefore the analysis of asymmetries of athletes' motor behavior is important in order to prevent injuries and to control the recuperation process.

The human lower limbs do not have a complete symmetric shape, which characterizes morphological asymmetry [1,3]. This might be a consequence of individual genetic factors and interaction with the environment during the motor development process [1]. Only very few studies of those that investigated lateral differences of lower limbs by functional movements, analyzed vertical jumps even though vertical jumps are frequent movements in many sports [1,4].

Basketball and soccer are sports where the ability of vertical jumps is an important factor of performance [4]. According to previous studies a basketball player performs about 65 vertical jumps in a game [4]. The motor profile of the lower limbs in soccer is characterized by shots, vertical jumps and fast runs and accelerations with changes of movement direction and velocity [6].

The countermovement jump on a double force platform where the ground reaction forces are separately measured for each leg is an adequate method to identify lateral differences of dynamic variables. This type of jump is frequently used as a test in Sport Science and Rehabilitation in order to evaluate motor ability [5,8,9] and the kinetic and cinematic characteristics of the countermovement jump are very similar to the functional and athletic movements which are mostly countermovements like shooting and throwing.

The type of physical demand of each sport may affect bilateral differences of the limbs. Therefore the aim of this study is the analysis of lateral differences of dynamic variables in countermovement jumps of basketball and soccer players, detected by a double force platform. Although the lower limb performance is very important for basketball and soccer players, the physical characteristics and demands are different in these sport games.

Materials and methods

Twenty six male athletes without recent injury history, 13 basketball and 13 soccer players, participated in this study. The basketball players were members of the Brazilian Kadett national team and the soccer players were members of two professional soccer teams of Belo Horizonte. The mean age of the basketball players was 16 years (sd = 0,5 years), their mean stature was 1,83 m (sd = 0,256 m) and their mean body mass was 85,03 kg (sd = 13,82 kg). The respective mean values of the soccer players were 20,92 years (sd = 0,64 years), 1,78 m (sd = 0,06 m) and 75,09 kg (sd = 5,38 kg).

Every athlete performed three countermovement jumps on a double force platform with a 60s recovery interval between the jumps. The jump with the best performance (highest rise of Center of Gravity) was selected for further analyses of lateral differences. The individuals were preliminary advised concerning the adequate movement technique. In order to avoid the influence of upper limb movement on the vertical momentum, the hands were fixed at the hips [10] and the athletes were requested to jump as high as possible (Figure 1).

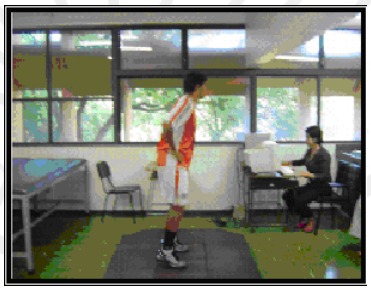

Figure 1: Countermovement jump on a double force platform.

The ground reaction forces were measured by a double force platform PLA3-1D-7KN/JBAZb (Staniak, Poland). The acquisition frequency of the signal was 1.000 Hz. Analyzing the force-time characteristics of the impulse phases of the right and left leg separately by the use of DasyLab V4.0 software, the following variables were determined: Maximal force, maximal power output and momentum. The differences of these variables between the right and left leg were calculated and amounts equal or greater than 15% were considered as lateral asymmetries [11].

Results

As table 1 shows, most of the soccer and basketball players (61,5% to 69,2%) are characterized by lateral differences concerning power output and momentum. Lateral differences in maximal force production can only be identified in a minority (15,4%) of the soccer and basketball players.

Table 1: Percentage of athletes with and without lateral differences.

Group		Maximal power output	Momentum	Maximal force
Soccer (N=13)	Symmetric	4 (30,8%)	5 (38,5%)	11 (84,6%)
	Asymmetric	9 (69,2%)	8 (61,5%)	2 (15,4%)
Basketball (N=13)	Symmetric	5 (38,5%)	5 (38,5%)	11 (84,6%)
	Asymmetric	8 (61,5%)	8 (61,5%)	2 (15,4%)

Table 2 informs about mean and standard deviation of the lateral differences of the analyzed variables.

	Group	N	Mean	Standard deviation
DIF_FMAX (%)	Soccer	13	0,068	0,565
	Basketball		0,067	0,665
DIF_I (%)	Soccer	13	,20648	,14573
	Basketball		,22023	,17653
DIF_Po (%)	Soccer	13	,22960	,14516
	Basketball		,30986	,27464

Table 2: Mean and standard deviation of lateral differences of the analyzed variables.
DIF_FMAX: difference of maximal force; DIF_I: Difference of momentum; DIF_Po: Difference of maximal power output.

The t-test for independent samples reveals that no significant differences between soccer and basketball players can be identified concerning lateral differences of the analyzed variables maximal force and power output and momentum (Table 3).

Table 3: Results of the t-test for independent samples comparing the investigated lateral differences between soccer and basketball players.

		F	T	Sig (2-tailed)
DIF_FMAX	Variância	0,083	-0,810	0,426
DIF_ID	Variância	0,041	-0,217	0,830
DIF_PMAX	variância	2,037	-0,932	0,361

DIF_FMAX: difference of maximal force; DIF_I: Difference of momentum; DIF_Po: Difference of maximal power output.

Discussion

The present study revealed that there are no significant differences between soccer and basketball players concerning lateral dynamic differences of lower limbs determined by countermovement jump. These results can not simply be compared with other studies because there is a lack of information analyzing lateral dynamic differences by ground reaction forces of countermovement jumps.

Lateral asymmetries lead to preferences in the exposure of one limb in relation to the other which may result in cumulative traumas, mechanical overload and compensation effects [12]. The incidence of injuries in only one lower limb, especially of athletes, points out the importance of the analysis of lateral differences [12]. Environmental factors are relevant for the development of lateral differences especially because of the great number of movement repetitions during the sport practice [13, 14]. The aim of the study of Garganta & Maia (1991) was the evaluation of power (rate of force development) of the lower limbs of volleyball and soccer players [6]. The results show that volleyball players had a higher level of power in vertical jumps than soccer players and that the performance of vertical jumps is able to discriminate elite and non-elite soccer players [6]. These results seem to prove that the time of practice and the type of demand of specific sport techniques lead to specific asymmetric patterns of the lower limbs.

The performance of vertical jumps involves different joints and bi- and mono-articular muscles. Therefore the impairment of any structure can be easily compensated by another one that apparently conceals lateral differences. For that type of movement it is not possible to standardize completely the manner of muscular contraction, angular velocities, movement amplitude and the relative positions of all limbs.

Otherwise these differences in relation to isolated analysis methods make the movement more similar to functional movement techniques in sports. The muscular power which results in the capacity of higher and faster jumps is a very important factor for the physical performance in different sports [4]. Jumps are also frequently used as forms of physical training [1].

Although the major physical demands of basketball players are characterized by lateral movements and landings after jumps the basketball players are dribbling the ball for a good deal of the time [4]. In contrast the soccer players demand basically the lower limbs for shooting, running and vertical jumps [4]. These facts show that jumps are different specific demands according to the sport [13].

Conclusion

Professional soccer players have similar lateral dynamic asymmetries as basketball players. That means that the different physical demands of soccer and basketball do not result in different lateral dynamic differences analyzed by a countermovement jump. **- *Key-words****: Vertical jump, lateral differences, dynamic variables*

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LATERAL DIFFERENCES OF MUSCULAR STRENGTH OF SOCCER AND BASKETBALL PLAYERS.

Summary

Lateral differences are caused by differences in motor ability, especially strength and coordination. Muscular asymmetry between the legs can lead to mechanical overload and compensatory mechanisms that result in movement and posture changes. Consequences of these lateral differences are higher injury risks and restrictions of sport performance. Therefore the analysis of asymmetries of athletes' motor behavior is important in order to prevent injuries and to control the recuperation process. The aim of this study was the identification of dynamic lateral differences of the lower limbs. 13 basketball, members of the Brazilian Kadett National Team, and 13 soccer players, members of two professional soccer teams, participated in this study. In order to identify lateral dynamic differences, the athletes performed countermovement jumps on a double force platform. The jump with the best performance was selected for further analyses. The symmetry was identified for maximal force, momentum and maximal power output. Most of the basketball and soccer players (61,5% to 69,2%) are characterized by lateral differences of maximal power output and momentum, but there were no significant differences between the two groups. Concerning the maximal force, only 15,4% of basketball and soccer players are characterized by lateral differences. Although the major physical demands of basketball players are characterized by lateral movements and landings after jumps, the basketball players are dribbling the ball for a good deal of the time. In contrast the soccer players demand basically the lower limbs for shooting, running and vertical jumps. These facts show that jumps are different specific demands according to the sport. However, the different physical demands of soccer and basketball do not result in different lateral dynamic differences.

Key-words*: Vertical jump, lateral differences, dynamic variables*

DIFFERRENCES LATERAUX DE LA FORCE MUSCULAIRE DES JOUEURS DE FOOTBALL ET DE BASKET-BALL

Sommaire

Les différences latéraux proviennent des facteurs reliés avec les capacités fisiques, surtout à la grandeur de la force musculaire et coordination moteure. L'asymétrie musculaire interlatérale peut amener à la surcharge et compensation et changer le mouvement et la posture. Ainsi, les différences lateraux peuvent déchaîner des lésions et compromettre la performance dans l'activité sportive. En consequence, l'analyse de la symétrie du comportement moteur de l'athlète est importante pour la prévention et accompagnement postlésion. Le but de cet étude a été identifier différences lateraux à travers variables dynamiques dans les athlètes. À la recherce, ont participés 13 joueurs de basket-ball et 13 joueurs de football. Pour l'analyse des différences lateraux, ont été realisés des sauts verticaux dans des plate-formes duple force. On a choisie le meilleur saut pour l'analyse de la symétrie bilatérale. Malgré les mouvements lateraux et d'atterrissage de salt dans le basket-ball, les joueurs de football demandent basiquement les membres inférieurs pour donner des coups de pied, courrir et sauter verticalement. Ces facteurs suggèrent que l'habilité pour sauter est spécifique du sport. Cependant, différences dans la demand fisique du basket-ball et du football, ne resultent pas en asymétries différentes parmi les groups. Dans cet étude on a identifié un comportement asymétrique des valeurs moyennes des variable force maxime, puissance et impulsion pour les deux population recherchées.

Mots clefs: saut vertical, différences lateraux, variables dinamiques.

DIFERENCIAS LATERALES DE LA FUERZA MUSCULAR DE LOS JUGADORES DE FÚTBOL Y DE BALONCESTO

Resumen

Las diferencias laterales provienen de los factores relacionados con las capacidades físicas, sobretodo la

magnitud de la fuerza muscular y de la coordinación motora. La asimetría muscular interlateral puede causar a la sobrecarga y compensaciones, modificacando el movimiento y la postura. De esta forma, las diferencias laterales pueden desencadenar lesiones y, en la actividad deportiva, comprometer el desempeño. Por lo tanto, el análisis de la simetría del comportamiento motor del atleta es importante para los fines preventivos y en acompañamiento pos-lesiones. El objetivo de éste estudio es identificar diferencias laterales a través de variables dinámicas en atletas. Participaron 13 jugadores de baloncesto y 13 de fútbol. Para el análisis de las diferencias laterales se ejecutaron saltos verticales en plataforma doble de fuerza. Fue elegido el mejor salto para el análisis de la simetría bilateral. La asimetría fue identificada con base en los valores de fuerza máxima, impulso y potencia máxima, valores superiores o equivalentes el 15% habíam sido considerados asimétricos. Identificando asimetría en la mayoria de los jugadores de fútbol por la variable impulso (61,5%) y por la variable potencia (69,2%). Resultados semejantes se encontraron en los jugadores de baloncesto puesto que el 61,5% de los jugadores fueron asimétricos por las variables impulso y potencia. No hubo diferencia significativa de los resultados entre los grupos. A pesar que en el baloncesto se requieren movimientos laterales y de aterrizaje de saltos, los jugadores de fútbol demandan básicamente los miembros inferiores para patear, correr y saltar verticalmente. Esos factores sugieren que la habilidad para saltar es específica del deporte. Sinembargo, diferencias en la demanda física del baloncesto y del fútbol, no resultan en diferentes asimetrías entre grupos. En el presente estudio se identificó un comportamiento asimétrico de los valores medios de las variables fuerza máxima, potencia e impulso para ambas poblaciones investigadas.

Palabras clave: salto vertical, diferencias laterales, variables dinámicas.

DIFERENÇAS LATERAIS DA FORÇA MUSCULAR DE JOGADORES DE FUTEBOL E DE BASQUETE

Resumo

As diferenças laterais decorrem de fatores relacionados com as capacidades físicas, sobretudo a magnitude da força muscular e coordenação motora. A assimetria muscular interlateral pode ocasionar sobrecarga e compensações, alterando o movimento e a postura. Dessa forma, as diferenças laterais podem desencadear lesões e, na atividade desportiva, comprometer o desempenho. Por isso, a análise da assimetria do comportamento motor do atleta é importante para fins preventivos e no acompanhamento pós-lesão. O objetivo deste estudo foi identificar diferenças laterais por meio de variáveis dinâmicas em atletas. Participaram 13 jogadores de basquete e 13 jogadores de futebol. Para análise das diferenças laterais os atletas realizaram saltos verticais com contra-movimento na plataforma dupla de força. O salto com melhor desempenho foi selecionado para posterior análise. A assimetria foi identificada baseada nos valores de força máxima, impulso e potência máxima e foi identificada assimetria da maioria dos jogadores de futebol pela variável impulso (61,5%) e pela variável potência (69,2%). Resultados similares foram encontrados para os jogadores de basquete uma vez que 61,5% dos jogadores foram assimétricos pelas variáveis impulso e potência. Não houve diferença significativa dos resultados entre os grupos. Apesar de no basquete ser requerido movimentos laterais e de aterrissagens de salto, os jogadores de futebol demandam basicamente os membros inferiores para chutar, correr e saltar verticalmente. Esses fatores sugerem que a habilidade para saltar é específica do esporte. Entretanto, diferenças na demanda física do basquete e do futebol, não resultam em diferentes assimetrias entre grupos. No presente estudo identificou-se um comportamento assimétrico dos valores médios das variáveis força máxima, potência e impulso para ambas as populações investigadas.

Palavras chaves: salto vertical, diferenças laterais, variáveis dinâmicas.