122 - CONTACT MAT: DEVICE FOR MEASURING ASYMMETRY IN LOWER LIMBS

SÍLVIA RIBEIRO SANTOS ARAÚJO[1], RAFAELLA AMARAL FONSECA[3],
ANTONIO E. DE MELO PERTENCE[2], HANS-JOACHIM MENZEL[1], MAUROHELENO CHAGAS[1]
1 - Laboratório de biomecânica - EEFFTO/UFMG
2 - Departamento de engenharia mecânica - UFMG
3 - Departamento de fisioterapia - FASEH
BELO HORIZONTE - MINAS GERAIS - BRASIL
Silviaaraujo72@ufmg.br

1 INTRODUCTION

Lateral Differences regarding the magnitude of muscle strength are frequently found in the lower limbs (LL) and may be related to the preference of the lower limb to be used (dominant and non-dominant) and the skill performance (KRAMER, BALSOR, 1990; CAPRANICA et al ., 1992; ALMEIDA, VALLE, SACCO, 2001; CLARK, 2001; CROISI, REVEILLON, FERRET, 2003).

These differences frequently found between the lower limbs are expressed as a preference for using one of the limbs for carrying out motor actions volunteers during the activities of daily life and in sports activities (KRAMER, BALSOR, 1990; CAPRANICA et al., 1992; ALMEIDA, VALLE, SACCO, 2001; CLARK, 2001; CROISI, REVEILLON, FERRET, 2003). Such differences may be due to factors related to physical abilities, especially with the muscular strength and motor coordination (KRAMER, BALSOR, 1990; CAPRANICA et al., 1992; ALMEIDA, VALLE, SACCO, 2001; CLARK, 2001; Croisi, REVEILLON, FERRET, 2003).

The type of modality sports is a factor that interferes with the onset of lateral differences, because, most tasks are performed by limbs favorites since most athletes have a dominant leg to perform the technical requirements, which characterizes a unilateral demand which can result in differences kinematic and dynamic lateral differences.

Thus, lateral differences that outweigh values of normality should be diagnosed (YOUNG et al., 2001), therefore, the motor behavior asymmetric favoring the chronic causes of a limb over another, which can cause injuries (Schot et al., 1994). Often the injuries in the lower limbs affect only one side, which stresses the importance of diagnosis of the lateral differences (SCHOT et al., 1994).

Lateral differences of the knee strength (flexors and extensors) are often used in sports medicine to quantify the functional deficit subsequent to an injury and / or knee surgery, to monitor the effectiveness of rehabilitation programs and to decide whether an athlete is able to return to competition (CLARK, 2001; WILK, REINOLD, HOOKS, 2003; MCCURDY, LANGFORD, 2005; HAMILTON, Shultz, SCMITZ, PERRIN, 2008).

The lateral differences index considered normal pattern of lower limbs in the isokinetic test is over 90% and the vertical jump tests over 85%. If the values of different sides are lower than those cited in the literature probably the risk of injuries in lower limbs will be increasing (KNAPID, BAUMAN et al., 1991; NOYES, Barber, MANGINI, 1991; PESTSCHNIG, BARON, ALBRECHT, 1998; CROISIER, FORTHOMME et al., 2002; IMPELLIZZERI, RAMPININI et al., 2007). Therefore, lateral differences assessment may also be useful in identifying athletes with an increased risk for the occurrence of injuries in lower limbs during training and competition, which allows the execution of preventive work in order to minimize these differences.

Several methods have been proposed to evaluate the lateral differences between lower limbs muscle strength (Barber, NOYES et al., 1990; CLARK, 2001; ARAÚJO et al., 2007; HAMILTON, SHULTZ, SCMITZ, Perrin, 2008). Among these, the double force platform to measure strength is more suitable for diagnosing imbalances in LL, being considered gold standard. However, due to its high financial cost, it has become inaccessible for many coaches. Already the contact mat allows the verification and control the jumps performance, through the time of flight, with a relatively low cost. Thus, this study aimed to see if the contact mat is a device capable of diagnosing lateral differences related to the strength magnitude between LL in countermovement jump with one foot (SCMm) as the double force platform.

2 METHOD

29 healthy males and females with no prior history of knee injury (mean age 20,56 $\pm$ 2,25) volunteered.

The Vertical jump - double force platform test evaluated the impulse in the countermovement jump (CMJ). The subjects performed three trials with two minutes rest between jumps and were instructed to keep the hands fixed on the hips as the oscillation of the upper improves the height of the jump, thus interfering in the results (ASHBY, HEEGAARD, 2002; LEES et al., 2004; LEES, VANRENTERGHEM, CLERCQ, 2006, WALSH et al., 2007) and was the maximum effort to achieve a higher center of gravity. The feet were positioned in different channels of double force platform, both in location as the initial landing. The verbal command of the examiner marked the commencement of the movement. This device, the LL was tested simultaneously already on the contact mat so unilaterally. The jumps were randomly ordered and one week between test of rest.

The impulse (IP) generated in double force platform and the height of the jump (HS) on the contact mat of each leg were analyzed by percentage of asymmetries through the equation: high value minus the minor value divided by high value and then multiplied by 100, and were considered significant differences lateral percentages above 15%

To assess that there is relationship between the percentage of variables HS and IP to diagnose of asymmetries, the coefficient of contingency (C) of the means was analyzed by of SPSS 13.0.

3 RESULTS:

The coefficient of contingency result was C= 0.62, p=0.01. There is an association moderate and satisfactory between percentage of variables HS and IP.

4 DISCUSSION

The contact mat showed to be also an instrument able to identify asymmetries in strength magnitude of lower limbs when performed the CMJm. Thus, the Physical education and therapy physicals professionals may use a more accessible equipment to measure possible lateral differences of them beneficiaries for the prevention of injuries.

Araújo *et al. (*2007) verified a poor correlation existed between the asymmetry indexes in two functional tests to LL (the vertical test in double force platform and hop test for distance with one foot - HTC). Then it would seem that the platform measures might be more sensitive to limb asymmetry than the HTC. In contrast, Petschnig et al. (1998) found similar results for the limb

symmetry index between the vertical test and hop test for distance.

Menzel *et al*. (2008) analyzed 23 junior soccer players who performed a sprint test with alteration of movement direction (15m run with a 90° turn to the right side and a 15m run with a 90° turn to the left side after 7.5m) and a CMJ on a double force platform so that maximal force (Fmax), impulse (IMP) and peak power (PP). The results showered that the CMJ correlates significantly with sprint performance, this could not be observed for lateral differences in the sprint test and CMJ. It seems that lateral differences of sprints with alterations of movement direction also depend on other factors such as movement pattern and technique.

5 CONCLUSION

The results indicate that the contact mat device can be able to detect asymmetries in LL.

Suggest others studies that involve athletes, children, elderly with this experimental design are necessary.

REFERENCES

ARAÚJO, S. R. S. MENZEL, H.J.; CHAGAS. The relationship between vertical jump and hop test for distance (pilot study). M.H. Salzburg, Austria: *XXIV ISBS,* 491, 2007.

ASHBY, B.M.; HEEGAARD, J.H. Role of Arm Motion in the Standing long Jump. *Journal of Biomechanics*. 2002, n. 35, p. 1631-1637.

BARBER, SD.; NOYES, FR.; MANGINE, RE.; McCLOSKEY, JW.; HARTMAN, W. Quantitative assessment of functional limitation in normal and anterior ligament deficient knee. *Clinical Orthopaedic and Related Research*. 1990, v. 255, p. 204-214.

CAPRANICA, L.; G. CAMA; F. FANTON; A. TESSITORE; F. FIGURA. Force and Power of Preferred and non-preferred leg in young soccer players. *The Journal of Sports Medicine and Physical Fitness.* 1992, n. 31, p. 358-363.

CLARK, NC. Functional Performance Testing Following Knee Ligament Injury. *Physical Therapy in Sports.* 2001, n. 2, p. 91-105.

CROISIER, J. L., B. FORTHOMME, M. H. NAMUROIS**,** M. ANDERTHOMMEN, J. M. CRIELAARD. Hamstring muscle strain recurrence and strength performance disorders. *American Journal of Sports Medicine.*2002, n. 30, p.199-203.

CROISIER, J. L., V. REVEILLON, J. M. FERRET, et al. Isokinetic assessment of knee flexors and extensors in professional soccer players. *Isokinet. Exerc. Sci.* 2003, n. 11, p. 61-62.

HAMILTON, R.T.; SHULTZ, S.J.; SCHMITZ, R.J.; PERRIN, D.H. Triple-Hop Distance as a Valid Predictor of Lower Limb Strength and Power. *Journal of Athletic Training.* 2008, v. 43, n. 2, p. 144-151.

IMPELLIZZERI, FM.; RAMPININI, E.; MAFFIULETTI, N.; MARCORA, SM. A Vertical Jump Force Test for Assessing Bilateral Strength Asymmetry in Athletes. *Medicine & Science in Sports & Exercise.* 2007, v. 39, n. 11, p. 2044-2050.

KNAPIK, J. J.; C. L. BAUMAN; B. H. JONES; J. M. HARRIS; L. VAUGHAN. Preseason strength and flexibility imbalances associated with athletic injuries in female collegiate athletes. *American Journal of Sports Medicine.*1991, n. 19, p. 76-81.

KRAMER, JF; BALSOR, BE. Lower extremity preference and knee extensor torques in intercollegiate soccer players. *Can J Sort Sci*. 1990, n. 15, p. 180-184.

LESS, A.; J. VANRENTERGHEM, D.D. CLERCQ. Understanding How an Arm Swing Enhances Performance in the Vertical Jump. *Journal of Biomechanics.* 2004, p. 1-12.

LESS, A.; J. VANRENTERGHEM, D.D. CLERCQ. The Energetic and Benefit of an Arm Swing in Submaximal and Maximal Vertical Jump Performance. *Journal of Sports Sciences.* 2006, v. 24, n. 1, p. 51-57.

McCURDY, K.; LANGFORD, G. Comparison of unilateral squat strength between the dominant and non-dominant leg in men and women. *Journal of Sports Science and Medicine*. 2005, v. 4, p. 153-159.

MENZEL H, MORETZSOHN C, ARAÚJO S. R. S, CHAGAS M.H. Lateral differences of sprint and countermovement jump performance of soccer players. Seoul, Korea, *XXV ISBS*, p. 462, 2008.

NOYES, FR.; BARBER, SD.; MANGINE, RE. Abnormal lower limb symmetry determined by function hop tests after anterior cruciate ligament rupture. *The American Journal of Sports Medicine*. 1991, v. 19, n. 5, p. 513-518.

PESTSCHNIG, R.; BARON, R.; ALBRECHT, M. The relationship between isokinetic quadriceps strength test and hop tests for distance and one-legged vertical jump test following anterior cruciate ligament reconstruction. *Journal of Orthopedic and Sports Physical Therapy*. 1998, v. 28, n. 1, p. 23-29.

SCHOT, PK.; BATES, BT.; DUFEK, JS. Bilateral Performance Symmetry During Drop Landing: a Kinetic Analysis. *Medicine and Science in Sports and Exercise.* 1994, v. 26, n. 9, p. 1153-1159.

YOUNG, W; ELLIOT, S. Acute effects of static stretching, proprioceptive neuromuscular facilitation stretching, and maximum voluntary contractions on explosive force production and jumping performance. *Research quarterly for Exercise and Sport*. 2001. v. 72, n.3, p. 273-279.

WALSH, MS., BÖHM, H.; BUTTERFIELD, MM.; SANTHOSAM, J. Gender Bias in the Effects of Arms and Countermovement on Jumping Performance. *Journal of Strength and Conditioning Research.* 2007, v. 27, n. 2, p. 362-366.

WILK, K. E.; M. M. REINOLD; T. R. HOOKS. Recent advances in the rehabilitation of isolated and combined anterior cruciate ligament injuries. *Orthop. Clin. North Am.* 2003, n. 34, p. 107-137.

SILVIA RIBEIRO SANTOS ARAUJO
RUA TOPÁSIO, Nº 65, APTO 301
BAIRRO: PRADO
CEP: 30410-280
BELO HORIZONTE-MG
silviaaraujo72@ufmg.br

CONTACT MAT: DEVICE FOR MEASURING ASYMMETRY IN LOWER LIMBS

Lateral asymmetries concerning the magnitude of muscle strength are often found in lower limbs (LL) and are related to the preference of the limbs to be used (dominant and non-dominant) and the motor performance. How many sports require propulsion unilateral in directions horizontal and vertical, the unilateral assessment may be a procedure to assess the asymmetries of LL. The double force platform (DFP) is a device more suitable for diagnosing imbalances in LL, being considered "gold standard". However, it has become inaccessible for many coaches BY high financial cost. Already the contact mat (CC) allows the verification and control the performance of jumps, through the time of flight, with a low cost relatively. Thus, this study aimed to verify if the CC is a device capable of diagnosing asymmetries related to the force magnitude between LL in countermovement jump as the DFP. 29 volunteers were randomly evaluated in both tests. The jump height (HS) on the CC and impulse (IP) generated in DFP of both lower limbs were analyzed by percentage of asymmetries and is considered lateral asymmetry percentages above 15%. Each volunteer performed 3 trials with 2 minutes rest between jumps and one week between tests. In double force platform, the lower limbs were tested simultaneously, already on the carpet unilaterally. To assess the relationships between the means variables HS and IP to diagnose asymmetries, the coefficient of contingency (C) was used by SPSS 13.0. The result was C = 0.62, p = 0.01 was satisfactory and showed a moderate association between tests. Conclusion: The contact mat showed to be also an instrument able to identify asymmetries in the magnitude of the strength of LL when compared with double force platform. We suggest further studies with similar design to that, though involving athletes, sedentary individuals, among others.

TAPIS DE CONTACT: UN APPEL POUR LA MESURE DE L'ASYMÉTRIE DANS LES JAMBES

Les asymétries côté concernant l'ampleur de la force musculaire se trouvent souvent dans les membres inférieurs (LL) et de la préférence de la dominante membres et non-dominante et avec les performances du moteur. Comment de nombreux sports nécessiter propulsion unilatérale dans les directions horizontale et vertical. La plate-forme de double pouvoir (PDP) est indiqué pour le diagnostic des déséquilibres LL, être considéré comme "étalon or". Toutefois, en raison de son coût financier élevé, il est devenu inaccessible pour de nombreux entraîneurs. Le tapis de contact (TP) permet la vérification et de contrôle de la performance de saut avec un coût relativement faible. Ainsi, cette étude visait à vérifier si la TP est en mesure de diagnostiquer les déséquilibres liés à l'ampleur de la force entre LL countermovement dans un saut avec monopodal (SCMM) en format PDF. 29 volontaires ont été évalués de façon aléatoire dans les deux essais. La hauteur du saut (HS) dans le TP et de l'impulsion (IP) PDP des LL ont été analysés par le pourcentage des asymétries (des déséquilibres pourcentages au-dessus de 15%). Chaque bénévole a fait 3 tentatives avec un intervalle de 2 minutes entre les sauts et une semaine entre les épreuves. PDP dans les LL ont été testés simultanément, comme dans le TP de façon unilatérale. Pour évaluer l'existence de relations entre les variables et HS IP pour diagnostiquer les déséquilibres, en utilisant le coefficient de contingence (C) au moyen de SPSS 13.0. Le résultat est C = 0.62, p = 0,01 a été satisfaisante et a montré une association modérée entre les épreuves. Le TP s'est révélée être un instrument en mesure d'identifier les déséquilibres de l'ampleur de la force des membres inférieurs lors de la CMJm terme. Nous proposons de nouvelles études, de conception similaire à celle des athlètes, entre autres.

ALFOMBRA DE CONTACTO: UN RECURSO PARA MEDIR LA ASIMETRÍA EN LAS PIERNAS

Las asimetrías en relación con la magnitud de la fuerza muscular a menudo se encuentran en las extremidades inferiores (LL) y la preferencia de los relacionados con el miembro dominante y no dominante y con el rendimiento del motor. Cuántos deportes requieren de propulsión unilateral en las direcciones vertical y horizontal, la evaluación unilateral puede ser un procedimiento para evaluar las asimetrías LL. La plataforma de doble fuerza (PDF) estas indicado para uso en el diagnóstico de los desequilibrios LL, que se considera "patrón oro". Sin embargo, debido a su alto costo financiero, se ha convertido en inaccesible para muchos entrenadores. La alfombra de contacto (AC) permite la verificación y el control de la ejecución de un salto con un costo relativamente bajo. Por lo tanto, este estudio tiene por objeto verificar si el TP es capaz de diagnosticar los desequilibrios relacionados con la magnitud de la fuerza en el salto con 1 pie (SCMm) como un PDF. 29 voluntarios fueron evaluados aleatoriamente en ambas pruebas. La altura del salto (JE) en el TP y el impulso (IP) PDF de los LL fueron analisados por el porcentaje de las asimetrías, los desequilibrios que caracterizan por porcentajes superiores al 15%. Los voluntarios ha hecho 3 intentos con un intervalo de 2 minutos entre saltos y una semana entre las pruebas. PDF en las extremidades inferiores se han probado simultáneamente, como en TP de manera unilateral. Para evaluar la existencia de relaciones entre variables y HS IP para diagnosticar los desequilibrios, utilizando el coeficiente de contingencia (C) por. El resultado fue C=0,62, p=0,01 fue satisfactorio y mostró una moderada asociación entre las pruebas. La alfombra de contacto ha demostrado ser un instrumento capaz de identificar asimetrias en la magnitud de la fuerza de las LL cuando el CMJm plazo.

TAPETE DE CONTATO: UM RECURSO PARA MEDIR ASSIMETRIA EM MEMBROS INFERIORES

Assimetrias laterais referentes à magnitude da força muscular são freqüentemente encontradas em membros inferiores (MMII) e relacionam com a preferência do membro dominante e não dominante e com o desempenho motor. Como muitos esportes requerem propulsões unilaterais nas direções horizontal e/ou vertical, a avaliação unilateral pode ser um procedimento para avaliar as assimetrias de MMII. A análise da simetria do comportamento motor do atleta é importante para fins preventivos. A plataforma dupla de força (PDF) é o recurso indicado para diagnosticar assimetrias em MMII, sendo considerada “padrão ouro”. Porém, devido a seu alto custo financeiro, sua utilização torna-se inacessível para muitos treinadores. O tapete de contato (TP) permite a verificação e controle do desempenho de saltos com um custo relativamente baixo. Sendo assim, este estudo objetivou verificar se o TP é capaz de diagnosticar assimetrias referentes à magnitude da força entre MMII no salto com contramovimento monopodal (SCMm) tanto quanto a PDF. Foram avaliados aleatoriamente 29 voluntários em ambos os testes. A altura do salto (HS) no TP e o impulso (IP) da PDF dos MMII foram analisados pelos percentuais de assimetrias, caracterizando assimetrias laterais valores percentuais acima de 15%. Cada voluntário realizou 3 tentativas com um intervalo de 2 minutos entre os saltos e uma semana entre os testes. Na PDF, os MMII foram testados simultaneamente, já no TP unilateralmente. Para avaliar a existência de relações entre as variáveis HS e IP para diagnóstico de assimetrias, utilizou-se o coeficiente de contingência (C) por meio do programa SPSS *13.0*. O resultado foi de C=0,62, p=0,01 Foi evidenciada uma moderada e satisfatória associação entre os testes. O tapete de contato mostrou-se um instrumento capaz de identificar assimetrias na magnitude da força dos MMII quando executado o CMJm. Sugerimos novos estudos, com delineamento semelhante a este envolvendo atletas, idosos, dentre outros.