Retos. Nuevas tendencias en Educación Física, Deporte y Recreación
2014, nº 26, pp. 168-171

ISSN: Edición impresa: 1579-1726. Edición Web: 1988-2041 (www.retos.org).

Incorporation of a high-level soccer player into the team after a muscle injury: A case study

Incorporación de un jugador de fútbol de alto nivel en el equipo después de una lesión muscular: Un estudio de caso

Andrés Vargas Fuentes*, Iban Urkiza Ibaibarriaga**, Susana María Gil Orozko*
*Universidad del País Vasco, **Athletic Club of Bilbao

Abstract: The aim of the study was to observe the evolution of the external load of a soccer player who just joined the team after a recovered injury.13 male football players of a soccer team (20.9 ± 1.7 years, 1.80 ± 0.05 m, 73.1 ± 5.3 kg) belonging to the 2nd division B participated in this study. After 30 days off following a hamstring injury a player started to train with the team. The next week his injury relapsed, so he had to stop training for another week. Finally he was re-incorporated to the team. External load was measured in the injured player (P) and the rest of the players of the team (T) using GPS devices (GPSport) during week 1 and week 2. The variables measured were: distance at high intensity (DHI; >14 km/h) and distance at sprint (S; >24 km/h). Besides, the number of times they entered the different acceleration rates: (Acc) 1 (0-2 m/s/s), Acc2 (2-3 m/s/s) and Acc3 (3-5 m/s/s) and the number of times they entered the different deceleration rates: (Dec) 1 (0-2 m/s/s), Dec2 (2-3 m/s/s) and Dec3 (3-5 m/s/s). During the first week of training, P performed longer DHI and S than T. Moreover, P performed higher acc1, acc2, acc3, dec1, dec2 and dec3 than T. In contrast, during the second week, T performed longer DHI and S than P. However, P performed higher acc1, acc2, acc3, and dec1 than T. However, similar values were found in dec2 and dec3 in P and T. It was observed that the acc and dec in both weeks indicated a higher peripheral muscle work in P. Therefore, according to the nature of the injury a modification or even avoidance of certain exercises should be considered especially those exercises that directly impact on the repaired muscles.
Key words: Hamstring, injury, incorporation and football.

Resumen: El objetivo del estudio fue observar la evolución de la carga externa de un futbolista al reincorporarse al equipo después de una lesión. 13 jugadores masculinos de fútbol (20.9±1.7 años, 1.80±0.05 m, 73.1±5.3 kg) de un equipo de 2ª división B participaron en este estudio. Después de 30 días de baja tras una lesión en el músculo isquiotibial un jugador comenzó a entrenar con el equipo. Tras la primera semana, la lesion recidivó y se volvió a incorporar al equipo tras una semana de baja. La carga externa se evaluó en el jugador lesionado (P) y en el resto de los jugadores del equipo (T) utilizando dispositivos GPS (GPSport). Las variables medidas fueron: Distancia a alta intensidad (DHI; >14 km/h) y la distancia a Sprint (S; >24 km/h). Además, el número de aceleraciones (Acc) 1 (0-2 m/s/s), Acc2 (2-3 m/s/s) y Acc3 (3-5 m/s/s) y deceleraciones (Dec) 1 (0-2 m/s/s), Dec2 (2-3 m/s/s) y dec3 (3-5 m/s/s). Durante la primera semana de entrenamiento P realizó mayor DHI y S que T. Por otra parte, P realizó mayor cantidad de acc1, acc2, acc3, dec1, dec2 y dec3 que T. Por el contrario, durante la segunda semana, T realizó mayor DHI y S que P. Sin embargo, P realizó mayor cantidad de acc1, acc2, acc3 y dec1 que T. Valores similares fueron encontrados en dec2 y dec3 en P y T. En ambas semanas se observó un mayor trabajo muscular periférico en el jugador lesionado. Por lo tanto, de acuerdo con la naturaleza de la lesión una modificación o incluso la exclusión de ciertos ejercicios deben ser considerados; especialmente aquellos ejercicios que impactan directamente en los músculos recuperados
Palabras claves: Isquiotibial, lesión, incorporación y fútbol.

Introduction

Hamstring injuries are present in all soccer teams throughout the season. Recent studies have shown that 12-16% of all injuries in English and Australian professional soccer have been hamstring strain injuries (Connell et al., 2004). As result, soccer players were injured an average 18 days and could not compete in an average 3-3.5 matches due to hamstring injury (Orchard & Seward, 2002; Woods et al., 2004). Another feature of muscle strains is the recurrence rate, 34% of hamstring strains in the AFL being recurrences (Seward et al., 1993), making hamstring injuries one of the most common sources of injury and reinjury among footballers (Orchard et al., 1998).

However, there is a group of football players that shows an increased incidence of hamstring strains than any other. It has been found that there is a strong correlation between the optimum angle for the active peak torque and a previous history of injury (Brockett et al., 2004). It is thus that, previous injury has proved to be a relevant risk factor (Garrett, 1996; Upton et al., 1996). Into the bargain, hamstring strains were significantly associated with a low hamstring: quadriceps ratio of torque on the injured side hamstrings and low ratio side to side of the maximum torque (Orchard et al., 1997). However, others point out that hamstring strains are not related to a low hamstring: quadriceps strength ratio (Bennell et al., 1998). In brief, hamstring muscle strains are associated with eccentric contractions, where the contracting muscle is lengthened (Garrett, 1990; Kujala et al., 1997). Thereby many explanations have been proposed to explain the factors that cause the hamstring injury, such as muscle weakness and lack of flexibility (Burkett, 1970), fatigue (Garrett, 1996), insufficient warm-up (Worrell, 1994), and poor lumbar posture (Hennessy & Watson, 1993).

While hamstring strain injuries are common, our knowledge of the factors that predispose soccer players to injuries is scarce (Brockett et al., 2004; Verrall et al., 2001). One of the limitations of the studies is that the diagnosis of the lesions are carried out in the clinic, regardless of the factors present in the training field (Petersen & Hölmich, 2005).

To our knowledge, the training sessions of a soccer player after his recovery period (30 days off) from a hamstring strain injury has not yet been analyze. Therefore, the aim of the study was to observe the evolution of the external load of a soccer player who just joined the team after a recovered injury and to compare this load with the average load of the rest of the players.

Methods

Soccer Players

13 male football players, belonging to a national football second division participated in this study (20.9 ± 1.7 years, 1.80 ± 0.05 m, 73.1 ± 5.3 kg, 8.0 ± 0.9% fat percentage, VO_2max

Fecha recepción: 01-05-14- Fecha envío revisores: 02-05-14- Fecha de aceptación: 03-06-14
Andrés Vargas Fuentes
C/ Bulerías, 6 Bda.: El Sexmo
29570 Cártama, Málaga
entrenamientodea@outlook.com

56.06 ± 2.68 ml/kg/min). All players had a wide football training experience (11.8 ± 1.7 years). Prior to involvement in the investigation, all participants gave written informed consent after a detailed written and oral explanation of the potential risks and benefits resulting from participation in this study, as outlined in the Declaration of Helsinki (2008). The participants had the option to voluntarily withdraw from the study at any time. Ethics Committee of the University of the Basque Country, UPV/EHU, approved the study.

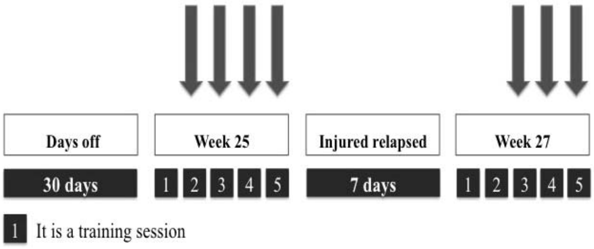

Figure 1: Distribution of the training sessions after the hamstring injury and the relapse.

Analysis, Validity and Reliability of GPS

The validity and reliability of GPS devices have been studied by several authors for application in football (Barbero-Álvarez et al., 2010; Coutts & Duffield, 2010; Portas et al., 2010; Varley et al., 2012; Vickery et al., 2013) as well as in others sports with high physical demands (Cunniffe et al., 2009; Lockie et al., 2013; Suárez-Arrones et al., 2013). In this way, the GPS devices seem to be reliable for the quantification of the physical load in both cases: matches and training session.

Testing took place across the centre of an open field, free from obstruction or adjacent buildings. All GPS units (GPSports, SPI-Pro, 15 Hz, Canberra, Australia) were simultaneously activated and left for 15 min. The GPS units (weight: 76 g, size: 48x20x87 mm; SPI Pro X; GPSports Systems, Canberra, Australia) sample at a rate of 15 Hz and are coupled with a 6 g tri-axial accelerometer sampling at 100 Hz. The typical number of available satellite signals ranged between 9 and 11 accompanied by a mean horizontal dilution of position (HDOP) of 1.2 + 0.2 throughout the test period. A GPS vest (GPSports, Canberra, Australia) was tightly fitted to each participant, placing the receiver between the scapulae. Each of the GPS device was carried by a single player, for the registration of a period per period. It followed a pattern-player GPS to keep the same device during matches (Jennings et al., 2010). The data were downloaded through the appropriate software (Team AMS R2; GPSports) and processed data using Microsoft Excel program (© 2013 Microsoft).

The distance at high intensity (DHI) (>14 km/h), and distance (S) at sprint (>24 km/h) were measured in meters (m) (Zubillaga et al., 2007). Also, the number of times each player accelerated or decelerated at different speed was recorded (times): acceleration (Acc) 1 (0-2 m/s/s), Acc 2 (2-3 m/s/s) and Acc 3 (3-5 m/s/s) and the deceleration (Dec) 1 (0-2 m/s/s), Dec 2 (2-3 m/s/s) and Dec 3 (3-5 m/s/s).

Design

After 30 days off following a hamstring injury a player started to train with the team. The next week (week 1, Figure 1) his injury relapsed, so he had to stop training for another week. Finally he was re-incorporated to the team (week 2, Figure 1). External load was measured in the injured player (P) and the rest of the players of the team (T) using GPS devices during week 1 and week 2.

Statistical Analysis

The statistical analysis was performed using the data analysis program Statistical Package for Social Sciences - SPSS 20.0.1. (SPSS Inc., Chicago, IL, USA). Descriptive statistics for the analysis of all the variables studied was performed. Values were presented as mean and standard deviation (±SD).

Results

During the first week of training (Table 1), the injured player performed longer distances at high intensity and sprint than the mean of the rest of the team (799.85 *vs.* 687.97±126.73 m and 45.50 *vs.* 41.72±31.03 m, for the injured players and the rest of the team, respectively). In contrast, during the second week (Table 1), the team performed longer distances at high intensity and distances at sprint than injured player (651.57±211.04 *vs.* 598 m and 30.67±26.58 *vs.* 21.70 m, respectively).

Table 1: Average values (mean and standard deviation) of the distance at high intensity (>14 km/h) and at sprint (>24km/h) of the injured player and team.

	Distance at high intensity (m)			Distance at sprint (m)		
	Team mean	SD	Injured player	Team mean	SD	Injured player
Week 1						
Day 2	463.7	106.1	629.4	3.2	5.4	5.4
Day 3	1158.5	134.1	1328.6	85.3	45.9	110.3
Day 4	699.8	130.7	559.8	66.5	58.6	20.6
Day 5	429.9	136.0	681.6	11.9	14.2	45.7
Week 2						
Day 1	972.2	268.4	737.8	34.0	26.0	22.7
Day 2	384.0	92.7	480.0	23.5	25.0	1.4
Day 3	598.6	272.1	576.2	34.5	28.7	41.0

During week 1 and 2 (Table 2), the injured player performed higher acceleration 1, acceleration 2 and acceleration 3 than the rest of the team (week 1: 148 *vs.* 109 2 3±27.03 times, 82 *vs.* 51.05±17.91 times, 37.50 *vs.* 19.11±11.59 times, 113.75 *vs.* 80.94±15.51 times, 41.50 *vs.* 31.45±8.31 times and 14.75 *vs.* 11.41±4.00 times, respectively and week 2: 169.67 *vs.* 126.96±38.70 times, 72.33 *vs.* 49.07±22.94 times, 24 *vs.* 14.19±8.18 times and 96.33 *vs.* 79.81±20.01 times, respectively).

Table 2: Average values (mean and standard deviation) of the number of times in acceleration 1, acceleration 2 and acceleration 3 of the injured player and team.

	Acc1 (times)			Acc2 (times)			Acc3 (times)		
	Team mean	SD	Injured player	Team mean	SD	Injured player	Team mean	SD	Injured player
Week 1									
Day 2	99.0	48.0	223.0	45.0	26.4	118.00	10.7	9.9	32.0
Day 3	160.3	24.5	161.0	72.8	14.0	94.00	39.4	20.1	62.0
Day 4	68.1	10.8	65.0	39.1	10.8	45.00	13.2	8.3	25.0
Day 5	109.6	24.8	143.0	47.3	20.5	71.00	13.1	8.1	31.0
Week 2									
Day 1	169.7	46.3	227.0	66.0	25.4	96.0	22.7	12.2	35.0
Day 2	99.7	28.1	125.0	34.1	15.9	52.0	11.0	6.8	15.0
Day 3	111.6	41.7	157.0	47.1	27.6	69.0	8.9	5.5	22.0

Acc: acceleration

Finally, the injured player performed higher number of deceleration 1, deceleration 2 and deceleration 3 than the rest of the team (113.75 *vs.* 80.94±15.51 times, 41.50 *vs.* 31.45±8.31 times and 14.75 *vs.* 11.41±4.00 times, respectively) during the first week of training (Table 3). And during at week 2 (Table 3), the injured player performed higher number of Dec1 than the team (96.33 *vs.* 79.81±20.01 times, respectively), and similar values were found in the number of deceleration 2 and deceleration 3 in the injured player and the team (25.67 *vs.* 26.74±9.99 times and 8 *vs.* 8.74±3.96 times, respectively).

Table 3: Average values (mean and standard deviation) of the number of times in deceleration 1, deceleration 2 and deceleration 3 of the injured player and team.

	Dec1 (times)			Dec2 (times)			Dec3 (times)		
	Team mean	SD	Injured player	Team mean	SD	Injured player	Team mean	SD	Injured player
Week 1									
Day 2	61.0	26.8	124.0	15.4	8.5	24.0	4.0	3.6	4.0
Day 3	127.9	12.7	141.0	54.3	7.9	64.0	22.9	5.0	29.0
Day 4	56.3	7.5	69.0	24.0	7.9	35.0	8.0	3.3	15.0
Day 5	78.6	14.9	121.0	32.1	8.9	43.0	10.8	4.1	11.0
Week 2									
Day1	101.2	23.6	116.0	35.6	12.3	24.0	11.6	3.5	5.0
Day 2	61.2	8.0	68.0	19.1	6.7	17.0	6.3	2.9	7.0
Day 3	77.0	28.4	105.0	25.6	11.0	36.0	8.3	5.5	12.0

Dec: deceleration

Discussion

This study quantified the external load of a football player after having recovered from a hamstring injury and the subsequent relapse of the same injury. Data showed that the intensity of the training of the injured player was probably too high after a fairly long recovery period of one month, and this could be the reason for the relapse of his injury. In this respect, during the first week all the variables of the training load were higher in the newly incorporated player compared to the rest of the team; whereas during the second week, training intensity was reduced. However, accelerations and decelerations in both weeks indicated a higher peripheral muscle work in the injured player than team due to constant changes of direction in different tasks requested workout.

It has widely been studied the relation of the high intensity training with the rate of injuries during a season as well as the duration and load of training despite planning of different kind of exercises (Anderson et al., 2003). Notwithstanding, the effort made by soccer players during the first days of training with the team is still unknown. This would be important due to the fact that it has been observed that when an athlete returns to his or her first runs on the field, the risk of complications and relapses is very high and soccer players may return to his team with an incomplete neuromuscular recovery (Gómez-Barrena et al., 2008).

On the other hand, hamstrings function should be also taken into account. Mainly, the hamstring muscles in its eccentric phase are responsible for controlling the phase of walking as well as the function of decelerating speed (Small, 2008). Eccentric contraction is more efficient than concentric contraction because it requires less oxygen but the tension generated during eccentric contraction is much higher than with concentric, generating higher intrinsic forces within the muscle and hence predisposing to injury. Disruption results in loss of normal eccentric control. And from here, player's tracking should be continued to recover totally. In particular, it has shown that the intensity of sprint has been identified as the major mechanisms of injury hamstring muscle (Woods et al., 2004). In the present study, the distance covered at high intensity and sprint velocity, and also the accelerations and decelerations that the injured player displayed were larger than the intensities and distances of the rest of the team. Maybe this player, willing to recover promptly and to outstand, trained at too high intensities when the muscles were not totally recovered.

Different physical tests have been used to measure the physical condition of players after an injury, but these test do not reflect the external load or fatigue expressed in a football match (Small, 2008), and therefore the transferability of results could limit the test´s findings and could not be extrapolated to the match.. According to this, the temporal pattern of the impact of hamstring strain during the match has revealed an increase in susceptibility to injury in the final minutes of matches (Woods et al., 2004) so it should take extra care at players reincorporated after injury to prevent relapse.

The limitation of the present study was that this is the description of a case study, particularly we analyze training load of a single player and consequently these results cannot be generalized. However, in our opinion the results are relevant and it would be desirable that more studies in a large number of players were conducted. For this, GPS devices may be an interesting tool in order to measure external load of injured players that start training with the team.

For the future, it would be very interesting to analyze the first phases of training days of players with some kind of injury, as this may have further implications regarding hamstring injury risk.

Conclusions

Hamstring injuries are common in football players because of the nature of the game itself (Fuller et al., 2006). Several studies have proposed the parameters that could cause the onset of the injury (Brockett et al., 2004; Orchard et al., 1997; Verrall et al., 2001). However, the impact of the weekly training in the recently incorporated player has not been analyzed yet. From the data of our study, we may suggest that training load should be controlled in order to prevent further stress of the affected muscle area using specific strategies to reduce intensity (Petersen & Hölmich, 2005; Petersen et al., 2011).

Moreover, the final phases of the rehabilitation preceding the return to sport of injured players must be performed on a specialized rehabilitation field under the control of specialists (Petersen & Hölmich, 2005) because an inadequate progression of the loads could put undue stress on players recently incorporated.

Therefore, players that join the team after suffering a hamstring injury should perform individual and progressive strength training exercises in order to achieve physical condition with similar values to those expressed by the team.

Acknowledgment

The authors would like to thank the players of the Bilbao Athletic Club. This study was partially supported by a grant from the Basque Government (IT700-13). AVF is supported by a predoctoral fellowship from the Basque Government (PIF/UPV/12/101).

References

Anderson, L., Triplett-McBride, T., Foster, C., Doberstein, S. & Brice, G. (2003). Impact of training patterns on incidence of illness and injury during a women's collegiate basketball season. *Journal of Strength and Conditioning Research*, *17*(3), 734–738.

Barbero-Álvarez, J. C., Coutts, A., Granda, J., Barbero-Álvarez, V. & Castagna, C. (2010). The validity and reliability of a global positioning satellite system device to assess speed and repeated sprint ability (RSA) in athletes. *Journal of Science and Medicine in Sport*, *13*(2), 232–235.

Bennell, K., Wajswelner, H., Lew, P., Schall-Riaucour, A., Leslie, S., Plant, D. & Cirone, J. (1998). Isokinetic strength testing does not predict hamstring injury in Australian Rules footballers. *British Journal of Sports Medicine*, *32*(4), 309–314.

Brockett, C. L., Morgan, D. L. & Proske, U. (2004). Predicting hamstring strain injury in elite athletes. *Medicine and Science in Sports and Exercise*, *36*(3), 379–387.

Burkett, L. N. (1970). Causative factors in hamstring strains. *Medicine and Science in Sports*, *2*(1), 39–42.

Connell, D. A., Schneider-Kolsky, M. E., Hoving, J. L., Malara, F., Buchbinder, R., Koulouris, G., Burke, F. & Bass, C. (2004). Longitudinal study comparing sonographic and MRI assessments of acute and healing hamstring injuries. *American Journal of Roentgenology*, *183*(4), 975–984.

Coutts, A. & Duffield, R. (2010). Validity and reliability of GPS devices for measuring movement demands of team sports. *Journal of Science and Medicine in Sport, 23*(1), 133– 135.

Cunniffe, B., Proctor, W., Baker, J. & Davies, B. (2009). An evaluation of the physiological demands of elite rugby union using global positioning system tracking software. *Journal of Strength and Conditioning Research*, *23*(4), 1195– 1203.

Fuller, C.W., Ekstrand, J., Junge, A., Andersen, T. E., Bahr, R., Dvorak, J., Hägglund, M., McCrory, P. & Meeuwisse, W. H. (2006). Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Bristish Journal Sports Medicine*, *40*(3), 193–201.

Garrett, W. E. (1990). Muscle strain injuries: Clinical and basic aspects. *Medicine and Science in Sports and Exercise*, *22*(4), 36–443.

Garrett, W. E. (1996). Muscle strain injuries. *American Journal of Sports Medicine*, *24*(6), 259–262.

Gómez-Barrena, E., Bonsfills, N., Martín, J. G., Ballesteros-Massó, R., Foruria, A. & Núñez-Molina, A. (2008). Insufficient recovery of neuromuscular activity around the knee after experimental anterior cruciate ligament reconstruction. *Acta Orthopaedica*, *79*(1), 39–47.

Hennessy, L. & Watson. A. W. S. (1993). Flexibility and posture assessment in relation to hamstring injury. *British Journal of Sports Medicine*, *27*(4), 243–246.

Jennings, D., Cormack, S., Coutts, A. J., Boyd, L. J. & Aughey, R. J. (2010). Variability of GPS units for measuring distance in team sport movements. *International Journal of Sports Physiology and Performance*, *5*(4), 565–569.

Kujala, U. M., Orava, S. & Jarvinen, M. (1997). Hamstring injuries: Current trends in treatment and prevention. *Sports Medicine*, *23*(6), 397–404.

Lockie, R., Schultz, A., Callaghan, S., Jeffriess, M. & Simon, P. (2013). Reliability and validity of a new test of change-of-direction speed for field-based sports: The change-of-direction and acceleration test (CODAT). *Journal of Sports Science and Medicine*, *12*(1), 88–96.

Orchard, J. & Seward, H. (2002). Epidemiology of injuries in the Australian Football League, season 1997–2000. *British Journal of Sports Medicine*, *36*(1), 39–44.

Orchard, J., Marsden, J., Lord, S. & Garlick, D. (1997). Preseason hamstring muscle weakness associated with hamstring muscle injury in Australian footballers. *American Journal of Sports Medicine*, *25*(1), 81–85.

Orchard, J., Wood, T., Seward H. & Broad, A. (1998). Comparison of injuries in elite senior and junior Australian football. *Journal of Science and Medicine in Sport*, *1*(2), 83–88.

Petersen, J. & Hölmich, P. (2005). Evidence based prevention of hamstring injuries in sport. *British Journal of Sports Medicine*, *39*(6), 319–323.

Petersen, J., Thorborg, K., Nielsen, M. B., Budtz-Jørgensen, E. & Hölmich, P. (2011). Preventive effect of eccentric training on acute hamstring injuries in men's soccer: A cluster-randomized controlled trial. *American Journal of Sports Medicine*, *39*(11), 2296–2303.

Portas, M. D., Harley, J. A., Barnes, C. A. & Rush, C. J. (2010). The validity and reliability of 1-Hz and 5-Hz global positioning systems for linear, multidirectional, and soccer-specific activities. *International Journal of Sports Physiology and Performance*, *5*(4), 448–458.

Seward, H., Orchard, J., Hazard. H. & Collinson, D. (1993). Football injuries in Australia at the elite level. *Medical Journal of Australia*, *159*(5), 298–301.

Small, K. A. (2008). *Effect of Fatigue on Hamstring Strain Injury Risk in Soccer*. University of Hull.

Suárez-Arrones, L., Gálvez, J., Díaz, I. & Arriaza, C. (2013). Intermittent performance in youth rugby union players and reliability of the GPS device to assess RSA with changes in direction. *Journal of Sport and Health Research*, *5*(1), 107–116.

Upton, P., Noakes, T. & Juritz, J. (1996). Thermal pants may reduce the risk of recurrent hamstring injuries in rugby players. *British Journal of Sports Medicine*, *30*(1), 57–60.

Varley, M. C., Fairweather, I. H. & Aughey, R. J. (2012). Validity and reliability of GPS for measuring instantaneous velocity during acceleration, deceleration and constant motion. *Journal of Sport Sciences*, *3*(2), 121–127.

Verrall, G. M., Slavotinek, J. P., Barnes, P. G. Fon, G. T. & Spriggins, A. J. (2001). Clinical risk factors for hamstring muscle strain injury: A prospective study with correlation of injury by magnetic resonance imaging. *British Journal of Sports Medicine*, *35*(6), 435–440.

Vickery, W. M. Dascombe, B. J., Baker, J. D., Higham, D. G., Spratford, W. & Duffield, R. (2013). Accuracy and reliability of GPS devices for measurement of sports-specific movement patterns related to cricket, tennis and field-based team sports. *Journal of Strength and Conditioning Research*, *28*(6), 1697–1705.

Woods, C., Hawkins, R. D., Maltby, S., Hulse, M., Thomas, A. & Hodson, A. (2004). The Football Association Medical Research Programme: an audit of injuries in professional football-analysis of hamstring injuries. *British Journal of Sports Medicine*, *38*(1), 36–41.

Worrell, T. W. (1994). Factors associated with hamstring injuries: An approach to treatment and preventative measures. *Sports Medicine*, *17*(5), 338–345.

Zubillaga, A., Gorospe, G., Hernandez-Mendo, A. & Blanco, A. (2007). Match analysis of 2005-06 Champions League Final with Amisco system. *Journal of Sports Science and Medicine*, *6*(10), 20.