

SHORT REPORT

Pre-Season Bilateral Strength Asymmetries of Professional Soccer Players and Relationship with Non-Contact Injury of Lower Limb in the Season

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Abstract

The aim of this study was to determine the relationship between bilateral pre-season strength asymmetries and the injury of the lower limb in the season. Examined group consisted of 227 soccer players playing in the highest league competition in the Czech Republic (age 25.44 ± 8.7 , body height = 182.1 ± 6.6 cm, body weight = 77.5 ± 6.9 kg). We measured the isokinetic strength of the flexors and extensors of the knee by using the Cybex dynamometer Humac Norm at 60 m.s⁻¹ angular speed and then we compared the bilateral asymmetries between the dominant and non-dominant lower limb in knee flexors and extensors. We retrospectively compare the injury to pre-seasonal bilateral strength imbalances between flexors and extensors of the knee. The results show that 65.9% of players who suffered non-contact leg injuries in the season had imbalances in knee extensors between preferred and non-preferred lower limb $\geq 10\%$ difference before the season and the percentage of injured players with bilateral asymmetry of knee flexors was 67.9%. These results predict that abnormal muscle asymmetry between the lower extremities may be one of the causes of injury in the area of lower extremities.

Key words: imbalance, muscle strength, non-contact injury, professional athletes, soccer

Introduction

The most soccer injuries are connected to the lower extremities, which is not unexpected, because soccer is described by high intensity and intermittent switches of direction at high loads (Wong & Hong, 2005). Most reports signified that soccer players are commonly within the extreme rates of strength asymmetry (Tourny-Chollet, Leroy, & Beuret-Blanquart, 2000; Weber, Silva, Radaelli, Paiva, & Pinto, 2010). According to Iga, George, Lees, and Reilly (2009), soccer players practically at no time use the both lower limbs by the identical prominence, this inclination is associated to the hemispheric authority of the brain on the reverse area, which may be the reason of an anomalous deficit in professional soccer players. Soccer players may suffer imbalanced

changes between the right and left leg as a effect of specific technical movements achieved in the game, and such asymmetrical pattern may cause functional or even structural disproportionateness (Schiltz et al., 2009). The authority of one segment of the body over the other constructs a better capability of the leading feature and can build the imbalance of strength of the several muscles that hang on the performances essential for sport.

Some soccer players have presented diversities in strength and flexibility between dominant and non-dominant legs (Rahnama, Lees, & Bambaecichi, 2005) and even biomechanical asymmetry between them (Dörge, Andersen, Sørensen, & Simonsen, 2002). Ekstrand, Hagglund, and Walden (2011) and Dick, Putukian, Agel, Evans, and Marshall (2007)



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found that nearly a third of all injuries in soccer are muscular injuries of hamstrings, adductors, quadriceps and calf muscles. Several reports have revealed a correlation between the strength of quadriceps and hamstrings and the increased risk of lower limb injuries (Croisier, Ganteaume, Binet, Genty, & Ferret, 2008; Cameron, Adams & Maher, 2003; Myer et al., 2009; Soderman, Alfredson, Pietila, & Werner, 2001). However, other studies present a minor association of weak thigh muscles and the risk of injury (Zvijac, Toriscelli, Merrick, & Kiebzak, 2013; A.H. Engebretsen, Myklebust, Holme, L. Engebretsen, & Bahr, 2010). Freckleton and Pizzari (2013) conducted several meta-analysis prospective studies in which they analyzed the knee muscle's isokinetic knee strength as a risk factor for hamstring injuries, indicating that the high quadriceps strength compared to hamstring was a significant risk factor for injuries to the back of the thigh muscles. One of the primary functions of ACL is to oblige the front translation of the tibia with respect to the femur. Activating hamstring muscles supports ACL in this function. ACL stretching is substantially reduced when hamstring and quadriceps are activated, compared with activation of only the muscular group quadriceps (Hewett, Ford, Hoogenboom, & Myer, 2010; Georgoulis et al., 2010). These and other conclusions (Boden, Sheehan, Torg, & Hewett, 2010; Withrow, Huston, Wojtys, & Ashton-Miller, 2008) suggest that imbalances in the strength of hamstrings may increase the risk of ACL injury.

The aim of this study was to determine the relationship

between bilateral pre-season strength asymmetries and the injury of the lower limb in the season.

Methods

The strength characteristics were observed in 227 healthy soccer players playing in the highest league competition in the Czech Republic. Tests of strength (knee flexors and extensors) were performed before the 2017/2018 season. Isokinetic strength parameters were monitored by using isokinetic dynamometer (Cybex Humac Norm®, USA), where we determined the maximum strength (PT) of extensors and flexors of the knee of the dominant and non-dominant limb at concentric contraction at an angular velocity of 60.s-1. We retrospectively compare the non-contact injury in season to pre-seasonal bilateral strength differences between flexors and extensors of the knee.

Results

The bilateral asymmetries ($\geq 10\%$) of the knee extensors (Q:Q ratio) has 29.05% of examined athletes. The percentage of players who suffered non-contact injuries in the lower limbs is 33.61%, of which 31.43% of injured players are in pre-seasonal imbalances above critical level, and 34.50% of injured players has 10% difference between preferred and non-preferred lower limb, indicating that up 65.50% of injured soccer players has pre-seasonal asymmetries ($\geq 10\%$) (Figure 1).

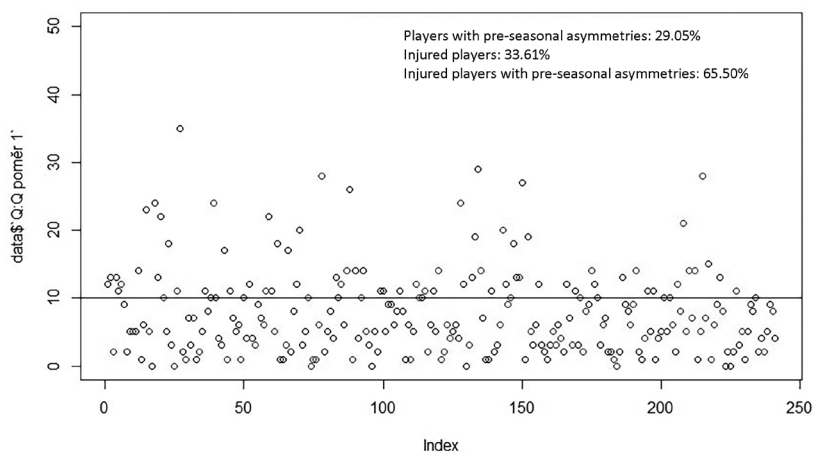


Figure1. Relationship between Q:Q ratio and injury

The ratio of players who were asymmetry in the knee flexors (H:H ratio) before season is 36.51%. The percentage

of injured soccer athletes with pre-seasonal bilateral asymmetries is 67.91% (Figure 2).

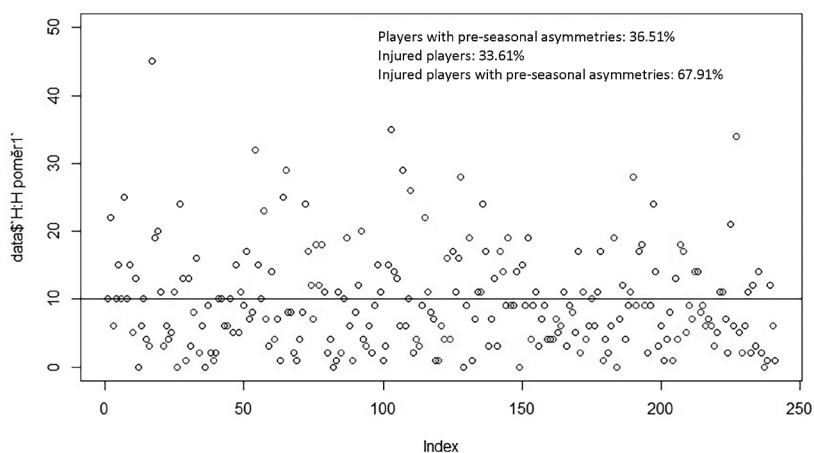


Figure2. Relationship between H:H ratio and injury

Discussion

The most injuries were occurred in the knee area. During the season, 21 non-contact knee injuries and 15 ACL ruptures were reported, with an average match deficit of 223 days. We monitored 20 non-contact knee flexor injuries, mainly due to stretching of the rear femoral muscles, and recovery was significantly shorter, on average for 14 days. The ankle bore occurred 17 times, and the other injuries accounted for only 8 injuries of different types. The Q:Q ratio represents the proportion of knee extensors between the dominant and non-dominant lower limb. In the our examined soccer players, with an angular velocity of 60°s⁻¹, the average bilateral relationship is 7.84±6.31%, large individual excursions being observed. The percentage of players with bilateral asymmetries (≥10%) of the knee extensors (Q:Q ratio) was 29.05%. The percentage of players who suffered non-contact injuries in the lower limbs is 33.61%, of which 31.43% of injured players are in pre-seasonal imbalances above critical level, and 34.50% of injured players are at 10%, indicating that 65.50% of injured athletes has pre-seasonal asymmetries (≥10%).

The ratio between the knee flexors between the preferred and the non-preferred lower limb represents the H:H ratio. Average values of H:H ratio (9.52±9.55%) are higher than Q:Q ratio in examined group. The ratio of players who were asymmetry in the knee flexors (H:H ratio) before season is 36.51%. The percentage of injured soccer athletes with pre-seasonal bilateral asymmetries is 67.91%. Tourny-Chollet et al. (2000) in their study concluded that the knee flexors on the dominant leg tend to be stronger than on the non-dominant flexor. The results of recent research show that most players show abnormal strength deficits (more than 10%) at all angular speeds (Rahnama et al., 2005; Daneshjoo, Rahnama, Mokhtar, & Yusof, 2013). Brito et al. (2010) examined the isokinetic knee ratio in sub-elite soccer players, and their results showed that ratios on the non-dominant leg showed higher levels than dominant leg ratios, especially in flexors of knee. Other studies agree on similar conclusions. In the analysis of the young soccer players, no meaningful correlations in the asymmetry of the knee extensors have been proved (Lehnert, Urban, Procházka, & Psotta, 2011; Silva, Nassis, & Rebelo, 2015; Forbes et al., 2009). These results are confirmed by further research by professional players (Teixeira, Carvalho, Moreira, Carneiro, & Santos, 2015; Zabka, Valente, & Pacheco, 2011; Zakas, 2006; Daneshjoo et al., 2013; Rahnama, Lees, & Bambaecichi 2005; Eniseler, Şahan, Vurgun, & Mavi, 2012). On the other hand, significant differences in imbalance were found in knee flexors (Bonetti, 2017). Fousekis, Tsepis, and Vagenas (2011) measured the actual risk factors of pre-season injuries to 100 professional football players, finding that players with muscular asymmetries of hamstrings are at greater risk of knee injury or hamstrings. ACL and hamstring are more susceptible to injury than the knee extensions due to hamstrings being used to protect against the anterior tibia transition to the femur, which occurs during violent impacts and sudden changes in the direction. The lower strength ratio between the flexors and extensors of knee extends the ACL pressure during these activities. Several studies have revealed a correlation between the strength of quadriceps and hamstrings and the increased risk of lower limb injuries (Croisier et al., 2008; Myer et al., 2009; Soderman, Alfredson, Pietila & Werner, 2001). However, other

studies present a minor association of weak thigh muscles and the risk of injury (Zvijac, Toriscelli, Merrick & Kiebzak, 2013; Engebretsen, Myklebust, Holme, Engebretsen & Bahr, 2010). These inconsistent findings can be caused by variety of research protocols (different angular speed, concentric or eccentric contraction), scores (maximum torque, HQ ratio, asymmetry measurement), research population (women, various sports) limbs, special injuries, (hamstrings, ACL rupture).

For players with a higher level of bilateral asymmetry (≥10%) in pre-seasonal testing, we presented that more than 60% of the injured players have right-left imbalances of 10% in flexors and extensors of knee. We observe a high percentage of players with imbalances between the dominant and non-dominant lower limbs, with more players displaying imbalances in flexors of knee, which may cause the lower limb injuries to predominantly the rupture of the ACL and other parts of the knee. The orientation of further research on this topic would be recommended by the widening of possible modifiable injury predictors such as shortened muscle length optimum, muscle flexibility of athletes, hip imbalances or non-modifiable factor such as muscle fiber types. Furthermore, it is possible to orient research only for certain types of injury (ACL or hamstring injuries) and its relation to imbalance, either in the area of the spine or in the lumbo-sacral region.

Acknowledgements

There are no acknowledgements.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Received: 14 March 2019 | **Accepted:** 21 April 2019 | **Published:** 01 June 2019

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