HAMSTRINGS ARE DANGEROUS FOR SPORT AND SPORT IS DANGEROUS FOR HAMSTRINGS

– Written by Cristiano Eirale and Jan Ekstrand, Qatar

Analysis of epidemiological studies assessing sports constantly rank hamstring injuries as one of the most prevalent factors resulting in missed playing time by athletes[1–3]. One could therefore conclude that hamstrings are dangerous for sport. Identifying the real incidence of hamstring injury in each sport is difficult due to the varying definitions used by different researchers. However, it seems universally accepted that hamstring lesions make up a substantial percentage of acute, sports-related musculoskeletal injuries with a prevalence of 6 to 25%, depending on the sport[4].

Hamstring injuries can occur in a variety of sports and movements. A high number occur in sports where the hamstrings are stretched eccentrically at high speed such as athletics[5], and in running contact sports such as Australian Rules football (AFL)[6], American football[7] and soccer[1,3,8]. Hamstring injuries can also occur in recreational sports such as water-skiing and bull riding, where the knee is forcefully fully extended during injury[9,10]. Within individual sports different positional roles dictate different physical demands, and it's seen that hamstring strains are far more common in positions in which sprinting is

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Image: Lionel Messi touching his right distal hamstrings during the 2013 Champions League quarter of final against Paris Saint Germain.

more often required[7,8,11], such as strikers in football.

HAMSTRINGS IN SOCCER: THE MAIN INJURY

Generally, muscle injuries are common in soccer[8]. Surveillance of injuries in the UEFA Champions League showed that muscle injuries make up more than 30% of all player injuries and cause about 1/4 of total time lost due to injury[12]. Over 90% of muscle injuries seen in this study involved four major muscle groups of the lower extremity: hamstrings, adductors, quadriceps and gastrocnemius[8]. Injury to the hamstring muscle group is reported to be the most common injury subtype representing 12% of all injuries and more than 1/3 of all strains[8]. These normally occur with an acute onset (70%) and in a non-contact situation (96%)[8]. The incidence of hamstring injury during matches and training sessions are 0.43 and 3.70/1000 hours of exposure, respectively. Accordingly, a professional male soccer team with 25 players may expect about five hamstring injuries each season, equivalent to more than 80 lost football days and 14 missed matches[8]. Despite a massive amount of recent research and consequent prevention programmes, hamstring injury incidence is not decreasing. These injuries undoubtedly have an impact on the performance of the team and consequently, on a club's economy. These considerations aside, when the injured hamstring belongs to Lionel Messi and the lesion occurs in a crucial period of the Champions League, the influences become widespread and significant.

HAMSTRINGS IN AUSTRALIAN FOOTBALL: AN EXAMPLE OF HOW THE RULES OF THE GAME AFFECTS INJURIES

As with the other football codes, hamstring injuries are responsible for the highest number of matches missed (20 per season per club on average), and sprinting is seen to be the main mechanism of injury. On average, each AFL club may expect six hamstring strains per season[11]. The recurrence rate (26% on average) has shown a steady drop over the last 21 years (P <0.01), declining from over 40% to an average of 13.5% in the last 3 years. Speculatively, this may be the result of more cautious return to play strategies.

Interestingly, AFL is a good example of how the rules of the game can affect the risk of injury. In 2006 the rules of AFL were changed in order to improve the spectacle of the event such that the breaks in play, and therefore rest time for players, were reduced[13]. Moreover, rule-makers have tried to reduce the amount of 'dead time', in order to achieve an effective 80 minutes of time 'in play'. The rule changes also effected an increase in the number of player interchanges from an average of around 30 to more than 100 per team, per game. An analysis of the effect of these rule changes on injury rate showed them to be protective against hamstring injuries. It seemed that the athletes benefited from the increased number of interchange 'rests' – players who had seven or more interchanges in the previous 3 weeks had approximately 25% less hamstring injuries. On the other hand, increased interchanges by one team

gave the opposing team a higher number of hamstring injuries: when a team made 60 or more interchanges during a game, the opposition had approximately 40% increased incidence of hamstring injury. We can interpret this data to mean that when players get more breaks during the game, as opposed spending the game chasing 'fresher' players, they are less likely to get a hamstring injury. The sum of these opposing forces are that hamstring injury rates have not fallen, rather their distribution has changed relative to these interchanges. This may point to the role of fatigue in hamstring injury, already hypothesised in soccer, where the rate of hamstring strains are seen to increase toward the end of each half[12].

HAMSTRINGS AND TRACK AND FIELD: WATCH OVER THE SPRINTERS

Thigh strain was the most common diagnosis (16%) in sports injury surveillance studies at the 2007, 2009 and 2011 IAAF (International Association of Athletics Federations) World Athletics Championships[14–16]. In a recent prospective study the most frequent diagnosis in sprinters was hamstring strain[17]. In athletics, the most common mechanism of hamstring injury is sprinting[18] and the most common injury site is the long head of the biceps femoris[5]. Biomechanical studies have shown that a powerful eccentric contraction in the late swing phase is the likely time when the hamstrings are most prone to injury[19] although others argue that hamstrings are at higher risk of injury in the early phase of sprinting[20].

HAMSTRINGS IN AMERICAN FOOTBALL: MIND THE PRE-SEASON

Muscle injuries are a cause of considerable disability in American football both at senior and high school level[21]. The injury rate per 1000 hours of exposure is 0.47 for trainings and 2.7 for matches, with relative match-training risk of 5.74.

While the impact of hamstring strains in American Football[7] is similar to other sports such as soccer and AFL, their temporal distribution is worthy of review, particularly from a prevention point of view.

The pre-season is seen to be a high risk period. Muscle strains account for 46% of practice injuries and 22% of pre-season game injuries. They are the second most common pre-season injury, with an injury rate of 1.79 per 1,000 athlete-exposures for practices and 4.07 per 1,000 athlete-exposures for games[22]. Furthermore, more than half (53.1%) of all hamstring injuries occurred in the 7-week pre-season, before the teams had even played their first regular-season game. This data is striking when compared with the 16-week regular season, in which only 45% of injuries occurred, and the post-season, in which only 1.1% of injuries occurred[7].

Almost 4/5 (78.9%) practice injuries occurred in the pre-season, with more than 70% of those occurring in July, the first month of football participation. The first month of National Football League (NFL) pre-season games, August, is also the month with the highest incidence of game injuries[7]. These high pre-season injury incidences are devastating not only because of their immediate impact but also because primary hamstring lesions are associated with decreased performance upon return to competition and have a high risk of re-injury during the competitive season[23]. Elliott et al[7] explain these results mainly with the relative deconditioning that occurs in the off-season. However, since this high incidence is not found in the pre-season period for other sports, training and match strategies should be reviewed in NFL. Moreover, sport-specific conditioning, particularly with regard to strengthening and maximum-velocity sprinting, is suggested[7].

IT'S ALMOST ALWAYS THE BICEPS FEMORIS MUSCLE

In soccer, as in similar sports[24], most (84%) hamstring strains affect the biceps femoris[1]; exactly the same results were found in AFL[25]. Interestingly, the percentage of hamstring lesions located at the semimembranosus (SM) and semitendinosus were almost identical (11% and 5% in soccer, 10% and 6% in AFL, respectively). In accordance with the findings in AFL[26], Ekstrand et al[1] found no relation between the specific muscles involved and lay-off time. There is no preferred leg for a hamstring lesion in soccer: Ekstrand et al[8] found that exactly 50% of the injuries will occur in the kicking leg.

STRETCHING IS DIFFERENT

Dancers suffer different hamstring injuries: their injuries mostly happen during stretching exercises, taking their limb out

Image: Paris Saint-Germain training session during their Qatar Tour 2019 in Aspire Zone. Doha, Qatar.

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to an extreme joint position. These injuries most often involve the proximal free tendon of the SM muscle and require much more time to come back to the pre-injury level[24,27,28] than the running type injury seen in football. This specific mechanism of injury with a combination of end range hip flexion and full knee extension can lead to a specific injury to the proximal part of the posterior thigh in other sports as well[29], although in these sports the stretching to end range knee extension combined with full flexion is seen to happen at higher velocity. Clinically it is imperative to inform the athlete that this type of injury, despite its relatively mild initial symptoms, generally implies a longer return to play time.

HIGH RATE OF RECURRENCE

Together with its high incidence and important time lost from competition, hamstring injuries have a high recurrence rate. As previously stated, in AFL it has been estimated that 1/3 of all hamstring strains are a recurrence of a previous lesion although quite recently it appears that this trend is improving, possibly because of a more conservative management approach[11]. High rates of recurrence have also been reported for American football (16.5%)[7], rugby union (21%)[30] and soccer (16%)[8].

In soccer, a study of elite professional football[1] showed that all the re-injuries (n=30) were in the biceps femoris muscle and none to the semitendinous and semimembranosus.

A majority of studies show that re-injuries cause longer absence from sport than acute injury[8,12,31] with just one recent paper showing no difference in lay-off time between re-injury and first injury[1]. The authors of this recent paper have speculated that this may indicate that top-level clubs in Europe have greater medical support, providing more individualised rehabilitation for injured players. These workers added that the frequently used radiological examinations for diagnostics and return-to-play decisions could possibly help to reduce the re-injury rate.

DO WE NEED IMAGING?

The majority of hamstring injuries occurring in players from European high-level professional football clubs were examined by MRI, US or a combination of these examinations. Imaging is frequently used to enhance the quality of the diagnosis in order to better prognosticate healing time and lay-off from football. At the elite level, the frequent use of imaging may also be justified by the scrutiny of the media and public of the health of these athletes. MRI has been the preferred modality in recent years and has offered a highly detailed imaging analysis of the extent of injury[1,25,26]. It seems logical that radiological severity is correlated to clinical severity, thus indicating that an MRI examination done 24 to 48 hours after a hamstring injury could provide information about what absence is to be expected. Several studies in AFL and soccer[1,25,26,32,33] have shown the possibility of using MRI to predict lay-off time after hamstring injury. Clinically, proximity of the injury to the ischial tuberosity, as estimated both by palpation and MRI, is associated with longer time to return to pre-injury level[24]. The size of a strain, as seen on MRI, has the strongest association with recurrence[25,26]. While MRI seems to have similar potential to evaluate the prognosis as clinical examination[32], further subgrouping into injury type, intramuscular location and dimension of pathology might be of additional value in prognosis[33]. Despite this data, it is our opinion that ultrasound is at least as valid as MRI for the evaluation of hamstring strains[34].

PAIN DOESN'T ALWAYS MEAN STRAIN

Not all causes of posterior thigh pain are the result of a hamstring muscle strain[35]. Ekstrand et al[1] have shown that 13% of MRIs performed for a suspected hamstring strain are negative.

A negative MRI finding in the context of clinically suspected hamstring strain is associated with shorter recovery time[1,25,26]. The actual cause of posterior thigh injury where MRI shows no pathology is unclear. It is possible that these injuries are subtle muscle injuries and below the sensitivity of MRI detection[26]. Another explanation is that these athletes in pain may have an alternative diagnosis such as back-related problem, neural tension or muscle spasm[25].

Image: Proximal hamstring avulsion surgical repair.

SURGERY IS RARE

Surgical repair is normally reserved for ruptures (mainly proximal avulsion injuries) but these are rarely seen in football: the UEFA Champions League hamstrings sub-study has shown an incidence of 3%[1]. Complete avulsions are more common with sports such as water-skiing, dancing, weight lifting, and ice-skating. In this case, the mechanism of injury is commonly through an eccentric contraction with the hip flexed and the knee extended[10,36].

HAMSTRINGS IN QATAR

The incidence of hamstrings strain in professional football in the Qatar Stars League (QSL)[3] is almost identical to the UEFA Champions League (UCL)12 (0.927 vs 0.924/1000 hours). However, the percentage of hamstrings strains in the total number of injuries is a little higher (18% compared with 12% in Europe). More than half of the observed muscle strains are located in the hamstrings.

This difference is due to the fact that the total injury incidence in Qatar is lower than in Europe, both in training (3.2 vs 4/1000 hours) and in matches (18.9 vs 25.0/1000 hours) (Figure 2).

Similarities between QSL and UCL have also been found for hamstring strain severity (18±18 vs 19±17 days), while the recurrence rate in Qatar is slightly lower (12 vs 16%), also implying a lower impact in total days lost due to hamstring injury in Qatar.

NOT JUST "A LITTLE HAMMY TEAR"

The deeper we have delved into hamstring injury over the last few decades, the more we have learnt as clinicians. However, we are clearly still some distance away from being able to say that we have solved this problem. Time has been spent researching novel treatment approaches but hamstring management hasn't (objectively) gotten much better. Maybe therefore this is an injury we need to prevent rather than treat. The first step in a systematic approach needed to build an evidence base for prevention of sports injury is valid and reliable injury surveillance methods[37]. No doubt more dead ends await us, but we can hope that this information is feeding back into management and resulting in reducing the burden of this complex and difficult injury.

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References available at www.aspetar.com/journal

> ***Hamstring strains may be an injury we need to prevent rather than treat.***

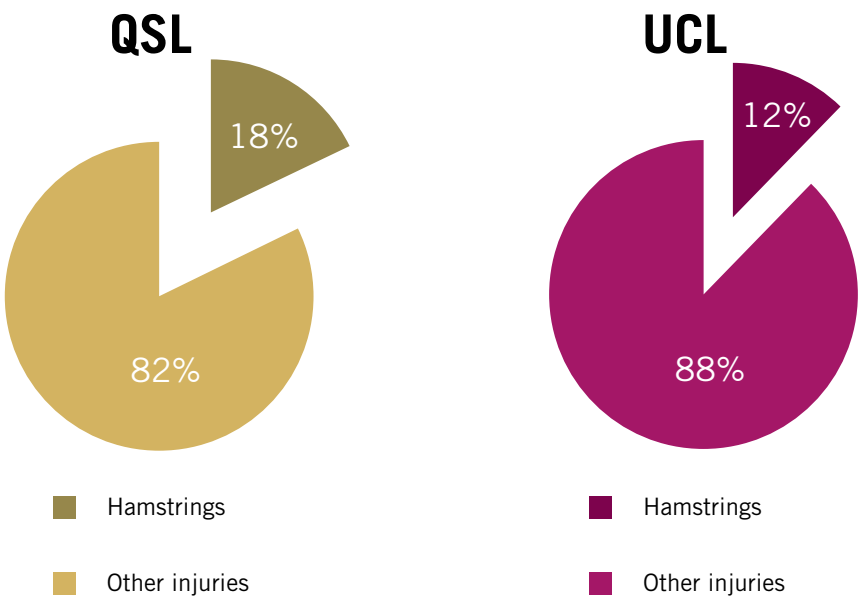

Figure 1: Percentage of hamstring injuries in Qatar Stars League (QSL) and UEFA Champions League (UCL).

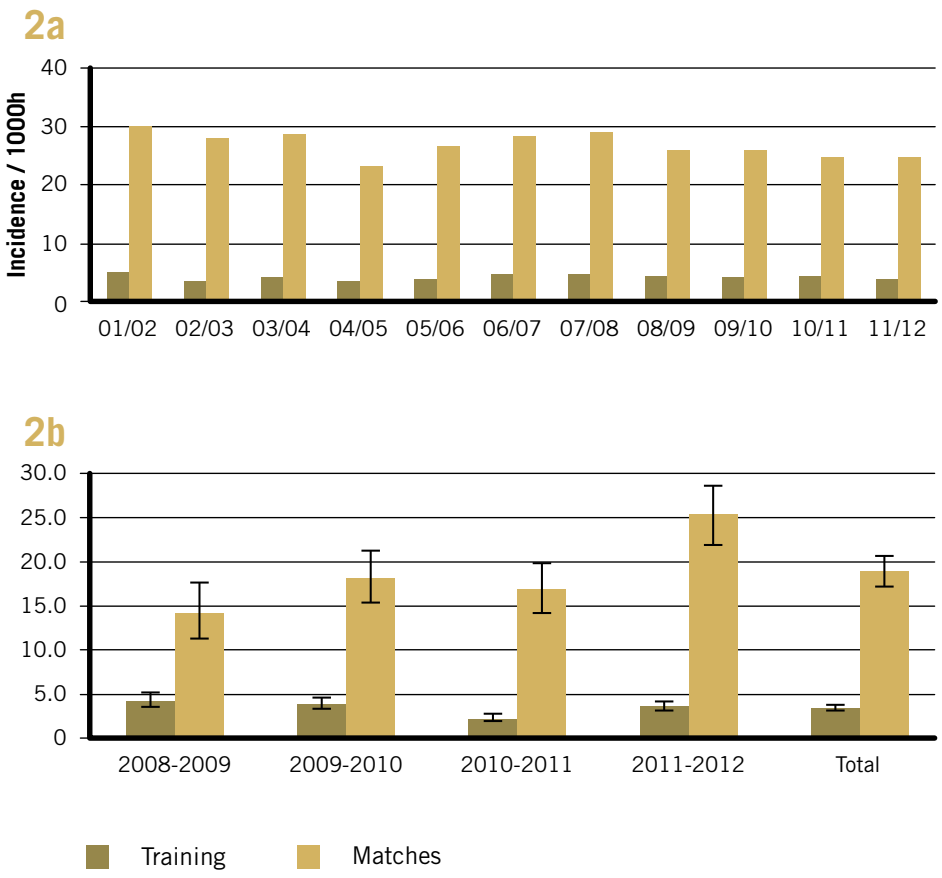

Figure 2: (a) Match and training injury incidence in UEFA Champions League (2001 to 2012). (b) Match and training injury incidence in Qatar Stars League (2008 to 2012).

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