Muscle injuries in Chilean professional soccer players

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Objective: To date, no description of the distribution of muscle injuries in Chilean professional soccer players is available. This study aimed to describe the distribution of muscle injuries among professional soccer players seen at a Chilean sports medicine centre over a 4 year period.

Methods: Ultrasound images were reviewed retrospectively of all professional soccer players (First and Second division) and juniors consulting for muscle injuries between November 2009 and September 2013.

Results: A total of 330 players (mean age, 25.6 years) presented with 514 muscle injuries. Biceps femoris was the most frequently affected muscle (26.1%), followed by the rectus femoris (22.6%), adductors (12.5%), semitendinosus (10.6%) and soleus (4.8%). An indirect mechanism accounted for 95.7% of the injuries. The ultrasound detected only muscle edema in 24.7% of injuries. The rest of indirect injuries were classified as myofascial (39.6%), fibrillar or multifibrillar (24.3%), fascicular (4.3%) and adherentiolysis (6.5%). Defenders were most frequently affected (33.2%), followed by midfielders (32.4%), forwards (28.2%) and goalkeepers (6.2%). Compared with the other field positions, goalkeepers had a higher proportion of rectus femoris and psoas injuries, but this was not statistically significant.

Conclusion: The muscles most affected in Chilean professional soccer players were the biceps femoris, followed by the rectus femoris. Defenders were most frequently affected, whereas goalkeepers tended to have a higher proportion of rectus femoris and psoas injuries than other field positions. Most muscle injuries are due to an indirect mechanism.

Key Words: Football, epidemiology, muscle tears, ultrasonography, sport injuries
INTRODUCTION

Soccer is one of the most popular sports in the world, having approximately 200,000 professional players and 240 million amateur players. The risk of injuries is high; in fact, the risk of a soccer related injury is 1,000 times higher than that of work related injuries in industrial workers. Muscle injuries represent 30-40% of total soccer-related injuries, and a professional soccer team of 25 players will suffer approximately 15 muscle injuries per year, resulting in a loss of more than 300 days of play.

Muscle injuries can be caused by direct or indirect mechanisms. Direct injuries are contusions or lacerations. Indirect injuries are the result of a tensional force that exceeds tissue resistance during muscle contraction. Indirect injuries are more frequent in biarticular muscles, in the myotendinous junction, and in type 2 fibers, during an eccentric contraction.

The most frequently affected muscles are the biceps femoris, followed by the adductors, sural triceps, quadriceps and semitendinosus. However, there is no study describing the distribution of muscle injuries in Chilean soccer players, which makes implementation of specific prevention strategies difficult. Furthermore, it is known that the first step in injury prevention is to evaluate the epidemiology of injuries.

The purpose of this study is to describe the distribution of muscle injuries among professional soccer players seen at a Chilean sports medicine centre over a 4 year period.

METHODS

A total of 29 First and Second division as well as Junior division soccer clubs, have agreements with the sports medicine centre for attending their injured players. Ultrasound images of all professional players from November 2009 through September 2013 were reviewed retrospectively and the characteristics of their muscle injuries were documented, including the body segment, laterality, affected muscle, type of injury, and size. The general player characteristics were also recorded, including age at the time of injury, dominant leg, and playing position in the field.

All images were reviewed by a radiologist specialized in musculoskeletal pathology. Injuries were classified as direct or indirect. Indirect injuries were subsequently classified according to Verdugo’s ultrasonography muscle injury classification as follows:

1. Muscle edema: No presence of discontinuity by ultrasound imaging.
3. Fibrillar or multifibrillar tear: Injury in the middle of the muscle, fine, variable length, no more than 2-mm thickness, with variable amount of perilesional edema. Very good prognosis heals without sequelae. When involving several losses of continuity, it is multifibrillar and will require a longer healing time, but still a favorable prognosis.
4. Fascicular tear: In the middle or periphery of the muscle, typically >3 cm, associated with blood collection. Healing time > 1 month.
5. Total tear: Injuries that leave some degree of functional loss. Tear of a thick segment, total tear of the myotendinous junction, tears with bone insertion avulsion.
6. Adherentiolysis: Scar opening or re-tear, usually partial, in the peripheral zone. Typically occurs during healing of an earlier injury. Corresponds to marginal fibrosis tear.

Finally, descriptive statistical analysis was performed using STATA 11.0 software. A p-value of <0.05 was considered statistically significant.

This work follows the World Association’s Declaration of Helsinki about ethical principles for medical research involving human subjects, and was approved by Ethics Committee at date October 2013. An informed consent was obtained from all subjects involved in the study.
RESULTS

Data of 514 muscle tears in 330 professional soccer players were collected. The mean age of the athletes examined was 25.6 years (range, 10–37 years). The distribution of muscle injuries by field position is shown in Figure 1. While the majority of injuries (52.7%) occurred in the dominant leg, this was not statistically significant (p = 0.32).

Overall, the biceps femoris was the most frequently affected muscle (26.1% of total), followed by the quadriceps rectus femoris (22.6%), adductors (12.5%), and semitendinosus (10.6%) (Figure 2).
The most frequently affected body segment was the thigh (80.8%), followed by the leg (11%), and hip (5.5%). In the segmental analysis, the most frequently affected muscles in the thigh were the hamstrings (39.4% of all injuries), followed by the quadriceps (29.1%) and adductors (12.5%). No statistical difference was found between the location of the tears in the thigh (proximal-third, 37.2%; mid-third, 31.4%; distal-third, 31.4%). In the leg, the soleus was most frequently affected (4.8%), followed by the medial head gastrocnemius (4.4%), lateral head gastrocnemius (1.3%), and tibialis anterior (0.38%). Flexor hallucis longus and peroneus longus injuries were rare (n = 1).

Only 4.3% of muscle injuries resulted from a direct mechanism, specifically contusions. The ultrasound image showed only edema, without a tear, in 24.7% of the cases. The rest of indirect

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**FIGURE 3.** Distribution of indirect muscle injuries by ultrasound classification.
injuries were classified as myofascial (39.6%), fibrillar or multifibrillar (24.3%), fascicular (4.3%), and adherentiolysis (6.5%). One case was classified as a total tear (Figure 3). Larger injuries tended to be fascicular (mean length, 60 mm), followed by contusional (mean length, 55 mm), myofascial (mean length, 34 mm), and lastly adherentiolysis and fibrillar or multifibrillar (mean length, 20 mm); this difference was statistically significant (p = 0.0001).

Goalkeepers tended to have the shortest muscle tears (mean tear length for goalkeepers = 20 mm; defenders = 30 mm; midfielders = 32.5 mm; forwards = 35 mm), but the differences were not statistically significant (p = 0.09). The most frequently affected muscle in goalkeepers was the quadriceps rectus femoris (34%), followed by the biceps femoris (25%), adductors and psoas muscle (9.4%). The biceps femoris (26.3%) was most frequently affected in defenders, followed by rectus femoris (24.7%), adductors and semitendinosus (11.1% and 10.5%, respectively). In midfielders, the most frequently injured muscle was the biceps femoris (25.1%), followed by the rectus femoris (18.6%), adductors (13.2%), and semitendinosus (10.8%). Lastly, in forwards, the biceps femoris (24.1%) and rectus femoris (22.1%) were the most frequently injured muscles, followed by the adductors (15.2%) and semitendinosus (11%) (Figure 4). No statistically significant association was found between the field position and the location of the injured muscle.

DISCUSSION

In our cohort of 330 professional soccer players from 29 clubs presenting with 514 total soccer-related injuries, the most frequently injured muscles were the biceps femoris (26.1%), followed by the quadriceps rectus femoris (22.6%), adductors (12.5%), and semitendinosus (10.6%). When grouped by body segment, the thigh was most frequently affected, specifically the hamstrings (39.4%), followed by the quadriceps (29.1%) and adductors (12.5%). These findings are consistent with those of other published series. Ekstrand et al. conducted an 8-year follow-up of 51 First Division European soccer teams, with a total of 2,299 players. They registered a total of 2,908 muscle injuries, with the hamstrings being the most frequently affected muscle group (37%), followed by the adductors (23%) and quadriceps (19%). Furthermore, Dauty et al., in an epidemiologic study of injuries of professional soccer players in France, found hamstring muscle injuries to be the most frequent.

Hamstring injuries typically occur during rapid acceleration or deceleration, quick change of
direction during sprinting at maximum speed or during jumping, and frequently at the end stage of the swing phase of gait.\textsuperscript{2,10} During the deceleration of knee extension, there is a quick and intense change from maximum eccentric to concentric contraction. It is during this rapid changeover that the hamstrings are most vulnerable to injury.\textsuperscript{11-13} Soccer players perform the previously described actions very frequently and are therefore highly vulnerable.\textsuperscript{14} This could explain the high frequency of hamstring injuries seen in soccer players.

Focusing on the hamstring, in our sample 66.3\% of injuries affected the biceps femoris, 26.8\% affected the semitendinosus, and 6.8\% affected the semimembranosus. In a study that specifically analyzed almost 800 hamstring injuries in First and Second division English soccer players, the distribution found was similar to ours with the biceps femoris being most frequently affected (53\%), followed by the semitendinosus (16\%) and semimembranosus (13\%).\textsuperscript{15} In the same study, the dominant and non-dominant leg injury frequencies were 53\% and 45\%, respectively, which is similar to the findings in our study with 52.7\% of injuries affecting the dominant leg.

Defenders were most frequently affected (33.3\%) in our study, followed very closely by midfielders (32.5\%), forwards (28\%), and, lastly, goalkeepers (6.2\%). The muscle injury frequency in goalkeepers is expected to be less because there are no more than three goalkeepers in a professional soccer team of 23 players. Moreover, only one goalkeeper is at play at any given time; therefore, the probability of injury is lower than for the rest of the players. These findings are consistent with the results obtained by other published series in that the highest frequency of an injury was found in defenders and midfielders, followed by forwards.\textsuperscript{16,17}

Compared with other field positions, goalkeepers had a higher proportion of quadriceps rectus femoris injuries (34.4\%) and psoas muscle injuries (9.4\%). While the association between the injured muscle and the field position was not statistically significant, it did indicate a trend, which could be due to the technical gesture executed during a goal-kick or punting (hip flexion combined with knee extension).

Only 4.3\% of injuries occurred via direct mechanisms, specifically contusion. Although contusion muscle injuries are relatively frequent in contact sports such as soccer, it appears they have less clinical significance than other injuries. Indirect injuries classified as myofascial and fibrillar or multifibrillar were most frequent, which coincides with those classified previously.\textsuperscript{7} Another important finding is that the size of the tear does not correlate to the type of the muscle injury ordered by severity (myofascial, fibrillar, multifibrillar, fascicular, total tear), so it is incorrect to assume that the size of the injury will correlate with the complexity of the tear.\textsuperscript{7}

This study has some limitations, particularly in that the true incidence of injuries cannot be calculated because the sample is comprised only of injured players and not the overall population of professional soccer players. Therefore, the risk for a particular injury cannot be estimated. There is also a selection bias because injuries were attended to in only one medical centre.

Despite these limitations, this is the first study to provide a general description of muscle injuries that affect Chilean soccer players. These findings will allow for improved design of injury prevention strategies. For example, some workouts for prevention of hamstring injuries exist.\textsuperscript{18} Knowing that this is the most frequently affected muscle group, utilization of these specific workouts could reduce the number of days of play lost. In addition, this study included data from a relatively long 4-year period; therefore, the results of this study can be considered valid for Chilean professional soccer players.

**CONCLUSION**

The most frequently injured muscles in First and Second division Chilean professional soccer players are the biceps femoris, followed by the quadriceps rectus femoris, adductors, semitendinosus, and
soleus. Defenders are most frequently affected players, followed by midfielders, forwards, and goalkeepers. Compared with the other field positions, goalkeepers tend to have a higher proportion of quadriceps rectus femoris and psoas muscle injury. Indirect mechanisms, particularly myofascial and fibrillar or multifibrillar, accounted for 95.7% of injuries.

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