

1
2 Prevention of hamstring and ankle injuries in soccer
3

4 **Summary**
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6 *The intention of this article is to review hamstring and ankle injuries to soccer players*
7 *and examine both the basis and etiology of these types of injuries. Particular*
8 *reference will be made to the optimisation of injury prevention providing scientific*
9 *evidence, which is limited for healthy soccer players. A logical progression involving*
10 *specific exercises will be provided to minimize injury to the hamstring muscle group*
11 *complex and the ankle.*
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13 Key Words: soccer, injury, prevention
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15 **Introduction**
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18 Soccer is one of the most popular sports worldwide with about 240 million registered
19 players (43, 66). Inevitably, the growth in participation has resulted in an increased
20 incidence of injuries within soccer, which shows no sign of declining (22, 48).
21 Certainly, higher levels of concentrated physical stress are placed upon top soccer
22 players today exposing them to a high risk of injury (20). According to Wong and
23 Hong (66) more injuries have been found in soccer than in similar team based
24 invasion sports including rugby, field hockey, handball and basketball. Injury is most
25 often defined as the cessation from sports participation and practice, which has
26 occurred during these activities (38). Regarding soccer injuries Rahnama et al. (40)
27 found an injury rate of 53 per 1000 hours played in the English Premier League.
28 Research conducted in both Europe and the United States has found approximately
29 83% of the injuries occur to the lower extremities (21, 37). Common injuries to the
30 lower extremities occur to the hamstring muscle group (68) and the ankle (37, 67).
31 Injury is a growing concern since it is the basic cause affecting an athlete's ability to
32 play in about 80% of all cases (61) while incurring considerable medical costs (39). It
33 is surprising; therefore, that limited research has been carried out to investigate

34 specific prevention program strategies for hamstring and ankle injuries in healthy
35 soccer players (38).

36

37 **Etiological factors for hamstrings injury**

38 The hamstring muscle group includes the semitendinosus, the semimembranosus and
39 the biceps femoris; the functions of which are as knee flexor and hip extensor. It has
40 been suggested that the vulnerability of injury to the hamstring muscle group is due to
41 their anatomical arrangement (38). These muscles have a pennate-elastic structure
42 and are biarticular meaning that a change in the length is brought about by movement
43 in two joints (24). Flexion of the knee and the hip occurs simultaneously during most
44 daily activities (38).

45

46 The biceps femoris is the most frequently injured hamstring muscle and, in most
47 cases, the injury occurs at or near the musculotendinous junction (11, 16, 25). Twelve
48 to thirty one percent of those who suffer from a hamstring injury are likely to
49 experience a reoccurrence of the injury (68). Understanding the risk factors that may
50 increase the likelihood of hamstring injury helps to plan effective injury prevention
51 programs; several risk factors for hamstring injury have been suggested including
52 improper pre-activity preparation, improper technique when running or cutting,
53 fatigue, previous injury, shortened hip flexors, overcompensation for gluteal muscles
54 weakness, strength imbalance, limited joint range of motion, and asynchronous firing
55 by the nerves which innervate the hamstring muscle group (4, 38, 47). Injuries are
56 multi-factorial and it is doubtful that any one risk factor will provide a complete
57 explanation for the hamstring injury. Indeed, Worrell and Perrin (69) have suggested
58 that a combination of aetiological factors increases the risk of hamstring injury. The
59 belief regarding strength imbalance is flawed since agonist-antagonist ratios change
60 with joint angle, velocity of movement, pattern of joint action, with multi-articular
61 action (50). Furthermore, ratios are influenced by the demands of the sport (28).
62 Isokinetic dynamometry assessment is the most commonly used method for assessing
63 muscular balance as it satisfies the reliability and validity criteria. Nevertheless, this
64 method of assessment is inadequate and it is misleading to advocate specific ratios
65 under specific laboratory conditions for prevention of injury since the current
66 measurement techniques do not correlate with complex sporting actions (17).

67 According to Stephens and Reid (57) a 0.60 to 0.70 muscle strength ratio is an
68 inappropriate hamstrings-to-quadriceps balance even when torque outputs are correct
69 for the effect of gravity. Bennell et al. (3) and Dauty et al. (10) found that isokinetic
70 strength testing does not predict hamstring injury in athletes. Monitoring the muscles
71 EMGrms activity during “functional” tests such as the vertical jump may be used to
72 facilitate diagnoses and direct treatment strategies of hamstring injuries (12).

73

74 Insufficient preparation in both short and long term training is considered a major
75 cause of injuries (55). Hawkins and Fuller proposed that poorly designed fitness
76 training programs have contributed to the incidence of injuries within soccer (19).

77

78 **Hamstrings injury prevention techniques**

79 With regard to the strength of the hamstring muscle group Mann (30) suggested the
80 muscle group strength should be as great as possible as it is the most critically
81 stressed muscle group in the lower extremity in both running and jumping. It is also
82 noted by other researchers that there is a greater contribution from the hip extensors
83 during faster running speeds (69, 74). When sprinting, the hip extensors work
84 eccentrically to a substantial degree to decelerate the leg during the last part of swing
85 phase or at foot strike (28). According to Brukner and Kahn (9) it is at these stages
86 when the majority of hamstring injuries occur. In fact, the impact of this within
87 soccer is that a number of hamstring injuries occur during sprinting activities (68).
88 Subsequently, it could be suggested that soccer players’ should incorporate hip
89 extensor exercises for example, pawback exercise, prone reverse hypers, glute-ham-
90 gastroc raises, all of which are critical for sprinting (6, 63).

91

92 Hamstring injuries occur during the eccentric action, when the muscle develops
93 tension while lengthening (26, 54). Eccentric forces are substantially greater during

94 higher velocities of running (33). Paradoxically the role of the muscle-complex as an
95 absorber of energy needs to be emphasised for the prevention and optimisation of
96 hamstring injuries. Indeed, specific eccentric action emphasis knee flexion training
97 may be effective in preventing hamstring injuries (1, 7, 8, 34). The Nordic hamstring
98 exercise (Figure 1) was utilized in the Brockett et al. and Mjolsnes et al. studies and
99 may be effective in preventing injuries to the hamstring muscle group (7, 8, 34). It is
100 noted that accentuation of the eccentric action is considered to be an effective means
101 of increasing flexibility and developing strength concurrently (36, 51). The exercise
102 was used in the special preparation of European sprinters during the 1980's (27). Key
103 benefits of the exercise are that it requires no expensive equipment and it can be done
104 anywhere; the only prerequisite being that the knees must be cushioned. It would be
105 advisable to carefully periodize the Nordic hamstring exercise into a program as
106 eccentric training tends to produce muscle soreness, referred to as 'delayed onset
107 muscle soreness,' to a significant degree predominantly in beginner trainees or
108 individuals unused to eccentric activity (14). Adaptation will occur providing training
109 continues and, consequently, muscle soreness will diminish (15). Accentuating the
110 eccentric action training would be used more frequently in the off-season than in the
111 in-season, as this method of training is associated with decreased rate of force
112 development (18, 41). It remains to be determined whether specific eccentric action
113 training at the hip joint would be beneficial for the prevention and optimisation of
114 hamstring injuries.

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116 The glute-ham-gastroc raise is a useful exercise that helps to prevent hamstring injury
117 as the exercise works both ends of the hamstring muscle group sequence, first at the
118 hip joint then at the knee joint (71). Finally, 'general' exercises such as squats,

119 deadlifts, pulls, step-ups, lunges will provide firm foundations for soccer players (6).
120 It would be prudent to militate against the use of the leg curl exercise, as the exercise
121 is not compatible to either the structure or function of the hamstring muscle group
122 (24).

123

124 **Etiological factors for ankle injury**

125 As identified in the introduction the ankle joint is susceptible to injury in soccer (37,
126 67). Presently the science concerning the risk factors associated with ankle injuries is
127 limited. However, risk factors which appear to increase the likelihood of ankle
128 sprains include subjects with slower running speed, less cardiorespiratory endurance,
129 less balance, decreased dorsiflexion muscle strength, decreased dorsiflexion range of
130 motion, less coordination, and faster reaction of the tibialis anterior and
131 gastrocnemius muscles (32, 65). However there is no consensus as to which of the
132 stated or additional risk factors may contribute to the incidence of ankle injury.
133 Needless to say a history of ankle injury is considered the strongest predictor of
134 further ankle injury (35).

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138 **Ankle injury prevention techniques**

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140 Various types of 'heel raises' have been advocated to strengthen the ankle (5). Rarely
141 are specific ankle strength exercises utilized that target the invertors and evertors,
142 which hold the ankle from twisting which is recommended for soccer players (70).
143 Strengthening the muscles of the foot and ankle not only helps prevent injury but also
144 may contribute to optimal soccer performance (59, 73). Researchers have suggested
145 that there are potential issues surrounding the strengthening of the ankle which
146 include, the time taken to complete the exercises, the duration to develop strength and

147 the insignificant visual changes to the structures (73). It can, therefore, be suggested
148 that the benefits of applying a structured strengthening program outweigh the
149 highlighted limitations.

150

151 Often ‘proprioceptive training’ with equipment such as wobble boards, balance
152 boards and core stability balls is recommended to prevent ankle injuries (13). Soccer,
153 as with many other sports, is a ground based sport; hence, the interaction of the
154 periphery and core creates ‘whole body stability’. Sports training should be specific,
155 therefore, performing exercises on an unstable surface such as a wobble board may
156 not transfer to exercises on stable surfaces (31). The use of unstable equipment for
157 ‘proprioceptive balance training’ has been found to be effective in rehabilitating ankle
158 sprains and reducing recurrence risk (2, 56, 58, 60); the mechanisms of which remain
159 speculative. However, it is suggested that technical training on a stable surface has
160 been found to be as effective for players with a history of ankle sprains (56). There
161 has been limited research conducted investigating the use of unstable training as a
162 primary preventative effect. Soderman et al. (53) found no effect of balance board
163 training on the incidence of ankle injuries as a primary preventative tool. In addition,
164 Willardson (64) and Verhagen et al. (60) report that there may be risks associated
165 with performing exercises on an unstable as opposed to a stable surface, which
166 requires further research. Performing activities on unstable objects requires different
167 change-in-support and compensatory actions than are required to dynamically
168 stabilize in real sporting situations (49). If there is a sudden unexpected imposition
169 of loading (e.g., a push), which occurs frequently in actual sporting situations, the
170 dominance of the periphery or distal segments assist the whole body in re-establishing

171 stability (49). Balancing drills on wobble boards, balance boards and core stability
172 balls prevent the stepping reflex, which takes place on stable surfaces.

173

174 Soccer requires the ability to dynamically stabilize as frequently players receive
175 random and impulsive contacts from opponents. Subsequently, appropriate balance
176 abilities can be developed within normal training practice, which apply the principle
177 of progressive overload moving from simple to more demanding and specific tasks.

178 Some examples may include, exercises such as working with a partner and attempting
179 to induce an in-balanced state through game related contact. Advancement of the
180 exercise could include changing the size of the support base during exercise
181 performance (31), using expected and unexpected stimuli or pushing a partner off
182 balance in locomotion. Temporary exclusion of certain senses may in fact, cause the
183 augmentation proprioceptive efficiency, for example performing tasks while
184 blindfolded (31, 52). An athlete who is able to predict the position of his or her body
185 in action is the one who is less vulnerable to injury (31). However, the
186 appropriateness of such occlusion drills would need to be questioned, as a player will
187 have visual cues within a game situation. The use of barefoot activities may also be
188 beneficial to, encourages the use of ball of the foot or mid foot strike, reduce the risk
189 of pronation injuries, preserve proprioceptive sensitivity and aid foot development
190 (44, 45, 46, 52, 62, 72). As with all supplement training tools blindfolded and
191 barefoot activities should be carefully integrated into the training of soccer players.

192

193 **Conclusion**

194 The intention of this article was to investigate the common injury sites for soccer
195 players; the hamstring muscle group (68) and the ankle (37, 67) and examine specific

196 programs which could be utilised to minimize injury to these areas. Incidences of
197 injuries in soccer are likely to continue to rise with increased participation. Within
198 sport prevention of injury is paramount (23) and based upon the high incidence of
199 injuries and ramifications of both ankle and hamstring injuries there is justification of
200 a prevention program for both sites. Despite this fact little scientific evidence exists
201 how to prevent ankle and hamstring injuries in soccer for healthy players and,
202 subsequently, coaches and support staff must take the initiative to develop appropriate
203 good practice. Attention needs to shift from rehabilitation to examination of primary
204 prevention methods. Many simple and cost effective preventative methods have been
205 proposed in this article, which may help to prevent injuries within soccer and reduce
206 the severity to the injury. Injury prevention methods must be appropriate to the
207 individual and phases of training; a logical progression of preventative training means
208 should be followed to ensure optimal results (Figure 2). Soccer players who have not
209 utilised injury prevention training means before should commence with simple tasks
210 of limited duration, speed, range of motion, load and then progressing to complex
211 training means integrating sport related activities; applying the principle of
212 progressive gradual overload. Adherence to these preventative means is essential
213 hence it would be advisable to integrate the program into either a session warm up
214 phase, specific conditioning or a game related session.

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218 **References**

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Logical Progression

