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Hamstring injury prevention: the strength assessment in young soccer players

Abstract

Aim: The hamstring strength training in youth soccer is relevant both for muscle injury prevention and for sprint performance increase. This study aim to assessment hamstring eccentric strength in young soccer players to know any lower limb strength asymmetries

Methods: The sample is composed of male young soccer players Under 17 (n=14, 16,6±0,5 years, 175,8±7,1cm and 70,9±9,1 kg). To assess the hamstring eccentric strength and the lower limb eccentric strength asymmetry have been used a specific dynamometer (NordBord Hamstring Testing System, Vald Performance, Australia) with software. Every young soccer player performed a single repetition of the Nordic hamstring exercise with constraint to the Nord Bord; after about 10 minutes, instead, they performed 5 repetitions of the same exercise, without interruption. All values were acquired using NordBord software: for both assessments, were detected the eccentric strength and the lower limbs strength asymmetry.

Results: The evaluation of the hamstring eccentric strength does not show substantial and statistically significant differences in the single test with reference to the peak parameter.

In the comparison between the average eccentric strength expressed in the 5 repetitions there is a statistically significant difference between the values expressed by the two limbs (p<0-05), and an increase in the value asymmetry is observed (15,8±5,4%).

Conclusion: This difference between the two tests leads us to think that the fatigue potential effect on the hamstring muscles deriving from the number of repetitions requested, can accentuate and highlight to a greater extent the differences between the hamstrings of the two lower limbs in the young player.

Keywords: hamstring, prevention, young soccer player

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Introduction

The hamstring strength training in youth soccer is relevant both for muscle injury prevention and for sprint performance increase.[1,2] The evident contrast between the amount of knowledge in the preventive exercises and the significant increase in top level and youth soccer injuries leads to the hypothesis that most of the scientific evidence is unable to permeate the training methodology organization.[2–4] In some contexts, there are difficulties in conducting the right preventive assessments; these difficulties may represent a limiting factor to the injury risk identification for a young athlete or for a specific muscle district. Epidemiological studies reveal that hamstring injuries characterize mainly sports that require maximum acceleration or high speed peaks: such injuries are particularly frequent in football, in the track and field fast run, in the football.[5–7] The need to hypothesize and organize preventative training sessions stems not only from what is known in terms of trauma frequency, but above all from the severity of the same which may entail a long time-loss from competitive events.[2,8]

For many years it has become evident that most injuries occur when the athlete is running at top speed or running at high speed;[9] on a sample of 109 runners of different athletics specialties, 12 hamstring injuries were observed, of which 9 were sprinters and only 3 were carried out by athletes practicing other running specialties;[10] in this regard, the literature reports that hamstring injuries for the mentioned sports range from 16% to 23% of the total[11–13] and that in fast-running specialties it can go up to 29% of the total[14] with particular reference to the biceps femoris. For other Authors, even more recently, it has been identified that the hamstring district injury is a worrying strong growth in sports that are based on fast runs and, therefore, mostly in track and field run specialties and some team sports.[15–17]

Even more recent epidemiological studies have highlighted how the muscle trauma in the hamstring district have taken a negative trend in recent years with a statistically significant increase in the last sports seasons.[18] And they highlight once again that injury risk is significantly higher in the match and/or in the race than in training.[18–20] The risk factors for hamstring injury are widely described in the literature (modest eccentric flexor force, imbalance between quadriceps and hamstrings, poor core stability, etc.) but lately, from prospective studies, it is evident that the strength asymmetry between the hamstring of both limbs (eccentric strength) and a history of previous injuries may increase the injury risk from 2.4 to 3.4 times, compared to conditions of greater muscle balance and/or to subjects who had never this type of muscle trauma.[2,15,16] Other Authors highlight other intrinsic factors of this muscular structure: the risk

factors analysis, in fact, cannot avoid considering, in addition to the specific functionality of each district and muscular architecture, the individual muscles innervation of the hamstring components,[21] as well as the different morphology.[22]

To this scenario are added the needs and the problems deriving from the sessions planning and from the training session typology choice,[23] as well as the congestion of the agonistic season. The preventive strategies organization can not characterize the top player or the adult athlete, but must be placed above all in the athlete training and athlete evolution process: in this phase the risk factors monitoring offers greater guarantees of long-term success. The identification at the young age of imbalances and strength asymmetries allow an early intervention that can contrast a potential injury risk scenario. Recent studies show that even in Under 20 soccer players the hamstring injury incidence has its relevance, reaching 18% of total traumas[24] or about 35%, according to other epidemiological studies;[25] even young players have very high risk factors of injury, such as reduced active flexibility, lower limb asymmetry, functional and core stability deficits.[24]

Despite the high incidence of hamstring injuries in the soccer players, the most recent literature does not seem exhaustive in addressing the issue of strength asymmetries and muscular imbalances in the young players circumscribing investigations to subjects over 18 years old and substantially to young adults;[26–29] therefore, an open problem remains the eccentric strength hamstring assessment and the lower limb strength asymmetry assessment in the young player. This study aim to assessment hamstring eccentric strength in young soccer players to know any lower limb strength asymmetries.

Methods

A. Participants

The sample is composed of male young soccer players Under 17 (n=14) belonging to a professional team, whose age, stature and weight were respectively of (mean ± ds) 16,6±0,5 years, 175,8±7,1cm and 70,9±9,1 kg. The young soccer players who had an hamstring injury in the previous 12 months, were excluded. The evaluation was carried out after receiving the parent informed consent and with the presence of the team's medical staff. Moreover, all participants were informed about the aim of the study and the relevance of the assessment.

a. Materials

To assess the hamstring eccentric strength and the lower limb eccentric strength asymmetry have been used a specific dynamometer (NordBord Hamstring Testing System, Vald Performance, Australia) with software. This tool detects the strength expressed during the Nordic Hamstring exercise.

b. Protocol

Before the evaluation all the participants followed a warm-up phase that was the same for everyone and included a low intensity running period (10 minute at 60% HRmax), exercises for dynamic stretching and mobility for the lower limbs, for a total duration of about 15 minutes. Each subject performed 3 tests to familiarize himself with the tool used in the session prior to the evaluation and knew the evaluated exercise. The assessment session organization had two phases: in the first, every young soccer player performed a single repetition of the Nordic hamstring exercise with constraint to the Nord Bord; after about 10 minutes, instead, they performed 5 repetitions of the same exercise, without interruption. All values were acquired using NordBord software: for both assessments, were detected the eccentric strength and the lower limbs strength asymmetry (Figure 1).

c. Statistical analysis

Descriptive statistics (M±SD) were calculated for all assessed variables; Student's paired t-test was used to verify the existence of statistically significant differences between the average values obtained. The significance was set at $p < 0.05$.

Figure 1 NordBord: the young soccer player starts the assessment in the traditional position of nordic hamstring.

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Results

The evaluation of the hamstring eccentric strength does not show substantial and statistically significant differences in the single test with reference to the peak parameter. In the comparison between the average eccentric strength expressed in the 5 repetitions there is a statistically significant difference between the values expressed by the two limbs (p<0-05), and an increase in the value asymmetry is observed. The evaluation of the hamstring eccentric strength does not show substantial and statistically significant differences in the single test with reference to the peak parameter. In the comparison between the average eccentric strength expressed in the 5 repetitions there is a statistically significant difference between the values expressed by the two limbs (p<0-05), and an increase in the value asymmetry is observed. The results are summarized in Table 1.

Table 1 Peak strength values and average strength values referred to the Nordic Hamstring assessment.*p<0.05

Left limb (Strength Peak, N)	Right limb (Strength Peak, N)	% Asymmetry	Left limb (Average strength, 5 reps, N)	Right limb (Average strength, 5 reps, N)	% Asymmetry
316,1±60,3	304,1±48,2	8,2±9,1	283,8±56,7	239,1±45,5*	15,8±5,4

Discussion

The care of player preventive factors can not start when the athlete reaches high levels of performance, but must characterize the entire sports training process both for functional and cultural reasons. The attention towards hamstring muscles in the field of soccer strength and conditioning must be even more assertive when looking at the data on the muscle trauma increase related to hamstring in the last 10-15 years.[18,20] And this incidence is also relevant in youth sport.[25] The study aimed to monitor the hamstring eccentric strength and to describe possible asymmetries between the two lower limbs in the young players. In the literature, as available, this is the first study that evaluates the hamstring eccentric strength and investigates the asymmetries between the lower limbs in young Under 17 players. As is the first study that uses a specific dynamometer for the strength hamstring with this type of sample. Only recently a study has highlighted the relationship between hamstring strength and sprint performance in young soccer players: it has emerged that the sprit performance increase is conditioned by the isometric hamstring strength.[1] The available studies concern young subjects over the age of 18 years[26–28] or with young adults assessed using isokinetic dynamometer.[29] More often, the analyzes of strength asymmetries concern the prevention of the injury risk,[30,31] the differences between the dominant/non-dominant limb,[31,32] specifically for the reduction of the anterior cruciate ligament rupture risk,[33–35] to understand differences between levels of different sport performance in youth football[35,36] or to describe the influences on sport-specific performance.[37–39] Hamstring strength were rarely investigated and limited to the analysis of muscle behavior in reference to sport-specific skills in soccer.[40]

From what emerges in this study the young soccer players does not seem to present relevant functional asymmetry values in the eccentric strength peak value. There I s a significant difference between the two lower limbs in the average eccentric strength after 5 repetitions. The high value standard deviation suggests that there is substantial heterogeneity in the evaluated sample, most likely characteristic of the age group considered; considering the standard deviation value, careful individual evaluation is necessary in order to define appropriate prevention strategies. The data that requires greater attention is the one related to the asymmetry that emerges from the strength values average in the assessment through the 5 repetitions.

This difference between the two tests leads us to think that the fatigue potential effect on the hamstring muscles deriving from the number of repetitions requested, can accentuate and highlight to a greater extent the differences between the hamstrings of the two lower limbs in the young player. The influence of fatigue, in fact, constitutes a variable strongly implicated in the hamstring injury etiology.[28,41] The analysis of the eccentric strength peak value obtained in the two limbs following a single test can be compared only with what is known about the top level soccer players, because in the literature there are no prospective studies conducted with young soccer players. For the past few years it has interesting data related to the hamstring injury risk thanks to a prospective study with soccer players belonging to eight different teams:[42] the eccentric strength values that are below 337N (and a length of the fascicle of the long head of the biceps femoris inferior to 10.56cm) exposes the subject to a greater injury risk.[42] The different sports qualifications of the two samples do not allow any useful comparison with the Under 17 values, but having such information can allow to monitor this motor ability until the transition in the maximum championship.

Finally, the study is an attempt to hamstring eccentric strength values analyze in the young player; represents a feasibility study of this investigation method and opens a series of perspectives for the young player preventive assessment. The study requires further study in relation to the influence of fatigue resulting from a number of sub-maximal repetitions to try to understand which type of fatigue can affect the lower limb asymmetry increase. Subsequent studies must further investigate this issue: a wider sample must be envisaged and eccentric strength must be monitored throughout the competitive season; it is necessary to understand if there are variations related to the session scheduling or/and the competition season phases.

Authors' contribution

Italo Sannicandro has contributed to the experimental design structuring, to the data statistics processing, to the results interpretation and study revising; Paolo Traficante has contributed to the data surveying; Giacomo Cofano contributed to the experimental design structuring, data surveying and results interpretation.

Conflicts of interest

No conflict of interest to be declared.

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