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Research Article

Effects of a Neuromotor Reeducation Program on Postural Control and Musculoskeletal Injury Incidence of Amateur Football Players

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Abstract

Few studies have been made about injury incidence in male amateur football teams, as well as about the effects of a neuromotor task training program in the prevention of injuries.We aimedto analyze the effects of an eight-week exercise program of neuromotor training on postural control and injury incidence in amateur male football players.Players of a team of 2B Portuguese Division (n=31, Mean -22.94 ± 4.12 years) participated in the study. Postural sway measures (centre of pressure, initial peak force and time to stabilization) were evaluated with a force platform within functional tests, before and after the application of an exercise program, which included football specific tasks like jumping and passing a ball with single leg landing. Injury assessment was made prospectively during the entire 2012-2013 season and there were 36 injuries registered. The mean injury incidence after intervention in the Training Group (TG) was lower than in the Control Group (CG), including ligament injuries (1.71 vs 3.11 injuries/1000h)and muscle injuries (1.37 vs 2.05 injuries/1000h). A significant improvement in postural control was observed in TG, demonstrated by the decrease of initial peak force (total of 45%) and time to stabilization (total of 50.9%) after a single leg landing. The application of this eight-week exercise neuromotor program had positive effects on the improvement of postural control, as well as on the reduction of injury incidence and time-loss after a ligament and muscle injury in amateur football players.

Keywords:

Postural control; Football; Incidence; Injury; Injury prevention; Neuromotor task training

Introduction

Injury incidence in football has been rising in the last years. The epidemiology of injuries in professional football teams has been well documented, but there are few studies regarding the amateur level [1,2]. Furthermore, there is no standard injury-prevention strategies created for this level. However, some methods have been described in preventive programs, like strengthening and stretching exercise programs, and neuromotor task training [1].

Neuromuscular control is very important in football, as dynamic stability of the lower limb is mostly performed using single leg stance.Some studies have reported an association between impaired neuromuscular control and incorrect movement patterns that increase the risk of injury [3,4].

The optimization of neuromotor system performance, by improving feedback and feedforward mechanisms, contributes to the enhancement of movement patterns, reducing the risk of injury and improving athletic performance [5]. It has been described as an important joint protection mechanism, especially in the prevention of ligament injuries [6]. This kind of training seems to be successful in reducing muscle reaction time, enhancing motor unit recruitment, improving balance and reducing risk of injury or injury recurrence [7]. Moreover, preventive training seems to be effective for most of the injuries with highest prevalence in football, such as ligament and joint injuries of the knee and ankle [8,9].

Neuromotor re-education exercise program optimizes neuromotor control by improving neuromuscular mechanisms and dynamic articular stability of athletes [10,11]. Indeed, an association between stability deficits and risk of injury in the lower limb has been found [3,4]. The exercise program should be sport specific, using the most demanding tasks for the control of dynamic stability [12-14].

Single leg landing has been commonly used to evaluate dynamic stability of the lower limb, especially ankle and knee joints [15,16]. This motor task, related with a common injury mechanism that occurs in football (landing after a jump), combines different components, such as articular stability, muscle strength and neuromuscular coordination [17,18].

Time to stabilization is considered to be one of the indicative measures of dynamic postural stability. It quantifies the time an athlete takes to stabilize balance after a jump in the landing phase. This measurement is made by considering the postural sway of the athlete in single leg stance. Initial peak force has been associated with the neuromuscular system capacity to absorb impact forces after landing, which is related to a decreased risk of injuries in articular and bony structures [18,19].

The aim of this investigation was to analyze the effects of a neuromotor training program in postural control and musculoskeletal injury incidence in amateur football players.

Material and Methods

Objectives

The goal of this study was to analyze the effects of applying a neuromotor exercise program on postural sway during different balance conditions (single leg stance and landing after a forward and medial jump) in amateur football players.

In addition, we aimed to evaluate the effects of this program on the prevention / reduction of musculoskeletal injuries in the same players during 2012-13 seasons.

Methods

The study began in the first day of 2012-13 football seasons. Individual characterization and the initial evaluation with a force platform were conducted for baseline data.

Sample

Twenty-five male football players (mean age 22.94 ± 4.12 years) were included in this study. This sample was divided into two groups: the Training Group (TG) composed of 13 male participants (mean age of 21.62 ± 3.38 years) and the Control Group (CG) composed of 12 male participants (mean of 24.83 ± 4.8 years). The participants had no previous experience in neuromotor exercises programs. Six players (3 players of TG and 3 players of CG) were excluded due to specific reasons, such as leaving the team during the study or having injuries not allowing the evaluation with the force platform during the balance tests tasks.

The team was constituted by: 3 goalkeepers (12.0%), 4 right/ left defenders (16.0%), 4 central backs (16.0%), 6 center midfielders (24.0%), 4 wingers (16.0%), and 4 strikers (16.0%). The mean players´ years of experience was 14.2 ± 4.9 years. Previous injury history, as well as the regular use of medication (antibiotics, NSAIDs and performance enhancing drugs) included in a questionnaire.These did not reveal /did not exclude any player from participating in the study.

Instrumentation

The postural sway measures were acquired using the Footscan system from RsScan International that is a device composed of a force platform and software for balance control analysis. This instrument allows quantifying the efficiency of the athlete's postural control.

Test tasks

Each athlete performed four tasks for each limb: a) single leg stance - eyes open; b) single leg stance - eyes closed; c) forward jump; d) medial jump. Each task was executed three times with the average value calculated for further data analysis. Data acquisition included Center of Pressure (CP) displacement (anterio-posterior displacement, medio-lateral displacement and sway area) in single leg stance and Time to Stabilization (TTS) and initial peak force (Body-Weight) after landing from forward and medial jumps. The sequence of the tasks was randomized in order to minimize the learning effect. Before measurements, each athlete completed a test trial of 20 seconds in single leg stance, with eyes open, as a familiarization task. For jumping tasks, the starting position was either behind or lateral to the platform, with a 15 cm high barrier.

Data acquisition was made before any training session to eliminate the influence of fatigue. All measurements were done without shoes, with instructions given to accomplish a soft landing.Two phases of evaluation were conducted: O1 - which was conducted on the first day of the 2012-13 football seasons; O2 – was conducted after eight weeks of a neuromotor exercise program.

During the 2012-13 seasons, injuries and time of exposure in competition and trainings were registered. Injury surveillance included a baseline medical questionnaire, daily participation exposure data and injury report forms. The severity of injury was classified based on consensus agreement for injury definition as slight (0 days of time-loss in football practice), minimal (1-3 days), mild (4-7 days), moderate (8-28 days) and severe (more than 28 days) [20].

This football-specific neuromotortask training program was applied over eight weeks in the beginning of the season, three times a week, with 15 minutes each session (total of 24 sessions). The program was elaborated based on previous studies and protocols [12,13,21]. The exercise program was constituted by nine exercises, with different types of surfaces, different kinds of stimulus and with increasing degree of complexity, such as developing from double leg to single leg landing on the ground; eyes-open to eyes-closed; performing football-specific tasks (heading and passing the ball) with unstable surfaces, such as the Freeman balance board and a stability foam pad. Each exercise was done in average two times for 30 seconds, followed by 30 seconds of rest.

This study was approved by the ethics and scientific committee of the Human Kinetics Faculty of University of Lisbon.

Statistics

We performed a t-test when the data followed a normal distribution and Mann-Whitney test for intergroup comparison and Wilcoxon test for intragroup comparison when the data was not normal. We considered statistically significant results presenting a p-value < 0.05.

Results

Injury incidence

During the 2012-13 seasons, a total of 36 injuries were registered (24 in the CG and 12 in the TG). The total injury incidence in the team during the season was 6.26 injuries per 1000 exposition hours (28.66 injuries per 1000 match hours and 4.02 injuries per 1000 training hours). The incidence was seven times higher during competition than during training.

Mean time-loss for injury

The mean time-loss for injury was 25.60 ± 39.39 days. The mean time-loss for injury in the TG was 10.42 ± 8.4 days and in CG 33.25 ± 46.29 days. Although there were no statistically significant differences between TG and CG (p=0.26), the TG had about 66% less time-loss due to injury, in comparison with the CG.

Anatomical region and type of injury

The ankle was the most common anatomical region injured (n=9 - 25%), followed by the knee (n=7 - 19.4%) and the thigh (n=6 – 16.7%).

Ligament injuries were the most common type of injury with 33.3% (n=12), followed by muscle injuries with 27.8% (n=10) and contusions with 11.2% (n=4).There were 4 contusion injuries during the season, and 10 other types of injuries, including tendon injuries, luxation and dental injuries.Acute onset injuries accounted for 33 out of 36 injuries.

Primary injuries vs recurrent injuries

There were 25 primary injuries (69.4%) and 11 recurrent injuries (30.6%). Recurrent injuries were mostly ligamentar (45.5%) and muscular (45.5%). From the 11 recurrent injuries, 6 occurred in the CG and 5 in the TG. The mean time-loss was significantly lower in the training group compared to control group (10.00 ± 8.75 days vs 32.50 ± 36.32 days) (p=0.08).

About 22 (61%) injuries had a traumatic mechanism and 14 (39%) were without external contact.From the 14 injuries without external contact, 11 (78.6%) occurred in CG and 3 (21.4%) in TG.

12 ligament injuries were registered, with a total incidence of 2.09 per 1000 exposure hours (Table 1). The incidence of ligament injuries of the ankle (n=9) was 1.56 per 1000 exposure hours and of the knee (n=3) was 0.57 injuries per 1000 exposure hours. There was a statistically significant difference in the meantime-loss due to ligament injury between the CG and the TG (p=0.04) (Table 1).

There were 10 muscle injuries, with an incidence of 1.74 injuries per 1000 exposition hours (0.96 injuries per 1000 training hours and 7.64 injuries per 1000 match hours) (Table 2). There were no statistically significant differences between the time-loss due to muscle injuries in the two groups (p=0.33) (Table 2).

Analysis of Postural Sway

For each jump task there were two variables analysed- Time to Stabilization (TTS) and Initial Peak Force (IPF) at landing. The values were registered during baseline evaluation (Control group - CG1 and Training group - TG1) before and after applying the neuromotor exercise program (Control group - CG2 and Training group - TG2).

	Ligamentar injuries (n)	Ligamentar injury incidence (injuries / 1000 exposure hours)	External contact (n)	Without external contact (n)	Time-loss (days)
Control Group	7	3.11	2	5	29.43 ± 23.82
Training Group	5	1.71	4	1	10.40 ± 2.88
Total	12	2.09	6	6	-

Table 1: Ligamentar injuries registered in the study.

	Muscle injuries (n)	Muscle injury incidence (injuries / 1000 exposure hours)	Time-loss (days)
Control Group	6	2.05	36.17 ± 37.71
Training Group	4	1.37	15.75 ± 12.2
Total	10	1.74	-

Table 2: Muscular injuries registered in the study.

Baseline center of pressure excursion measurements, as well as time to stabilization and initial peak force values showed no significant differences between groups.

In general, no remarkable changes were found after the eight weeks period in any of the groups in the eyes-open static conditions. In contrast, in the eyes-closed conditions TG participants showed a tendency towards a decrease in the center of pressure path length, as it can be seen in tables 3 and 4. The means ± standard deviations (mean ± SD) for each dependent variable are listed in Table 3 and 4. (Table 3 and 4)

	SSLCE DCP X (mm)	SSLCE DCP Y (mm)	SSLCE DCP Total (mm)	SSLCE Sway Area (mm²)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
CG 1	36.33 ±14.53	48.00 ± 25.74	632.03 ± 198.98	243.28 ± 224.80
CG2	36.64 ±14.62	48.30 ± 25.56	616.00 ± 299.13	277.81 ± 241.95
TG1	42.54 ± 27.27	49.08 ± 33.38	732.00 ± 589.06	239.38 ± 155.02
TG2	27.03 ± 5.42	31.26 ± 4.36	432.10 ± 90.04	130.31 ± 48.65

DCP X – CP Displacement in Medio-Lateral Direction**SSLCE** –Static Stance with left foot and closed eyes

DCP Y -CP Displacement in Anterior-Posterior Direction
DCP Total -CP Total Displacement Direction

CG1 – Control Group O1 **CG2** -Control Group O2 **TG1** -Training Group O1**TG2** – Training Group O2

Table 3: Resume Oscillation Postural Values.

	SSRCE DCP X (mm)	SSRCE DCP Y (mm)	SSRCE DCP Total (mm)	SSRCESway Area (mm²)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
CG 1	42.39 ±19.59	65.61 ± 39.08	751.06 ± 367.05	426.89 ± 491.23
CG2	34.61 ±12.69	54.64 ± 33.88	574.03 ± 309.94	806.78 ± 1406.47
TG1	45.56 ± 30.13	59.51 ± 37.86	735.56 ± 479.23	549.50 ± 1067.87
TG2	27.62 ± 3.62	33.54 ± 9.68	426.87 ± 87.86	180.91 ± 107.79

DCP X – CP Displacement in Medio-Lateral Direction**SSRCE** –Static Stance with right foot and closed eyes

CG1 – Control Group O1 **CG2** -Control Group O2 **TG1** -Training Group O1**TG2** – Training Group O2

Table 4: Resume Oscillation Postural Values.

The training group experienced a significant reduction in time to stabilization and in Body Weight (BW) in the initial peak force at landing (50.9% and 45%. respectively). No change ($p > 0.05$) occurred in time to stabilization and % of BW for the control group.

The most significant changes were seen in a landing after a medial jump with the left foot. During the first observation, the average time to stabilization in the TG was 2.92 ± 0.33 seconds and there was a reduction to 1.34 ± 0.42 seconds. Other values can be seen in Tables 5, 6, 7 and 8.

	LLIJLF TTS X (s)	LLIJLF TTS Y (s)	LLIJLF TTS VR ((√X2+Y2))
	Mean ± SD	Mean ± SD	Mean ± SD
CG 1	1.91 ± 0.31	2.04 ± 0.26	2.8 ± 0.35
CG2	1.97 ± 0.39	2.13 ± 0.33	2.92 ± 0.33
TG1	2.26 ± 0.58	2.46 ± 0.76	3.35 ± 0.89
TG2	0.95 ± 0.25	0.93 ± 0.41	1.34 ± 0.42

TTS X – Time to Stabilization in medio-lateral axis (X)**TTS Y** –Time to Stabilization in antero-posterior axis (Y)**TTS VR**-Time to Stabilization((√X2+Y2) **LLIJLF**– landing in a lateral internal jump withleft foot

CG1 – Control Group O1 **CG2** -Control Group O2 **TG1** -Training Group O1**TG2** – Training Group O2

Table 5: Resume Oscillation Postural Values.

Discussion

The main goal of this study was to analyse the effects of a neuromotor training program on postural control and musculoskeletal injury incidence in amateur football players. In this study, we found that: 1) The neuromotor training had a preventive effect oninjury incidence 2) Training group athletes had a lower mean time-loss due to injury 3) Training group athletes improved postural control strategies in landing specific tasks. The results obtained in current study concerning the injury incidence in the team were slightly lower (6.26 injuries per 1000 exposition hours) than the results reported in similar previous studies, such as the study ofGonçalves [21]and Mallo [22]reporting injury incidence of 9.05 and 10.9 injuries per 1000 exposition hours, respectively.

The data concerning the match injury incidence revealed 28.66 injuries per 1000 match hours, that is similar to the incidence values found in others studies (between 21 and 30 injuries per 1000 match hours)[23,24].Our data concerning injury incidence during training showed 4.02 injuries per 1000 training hours, which was very similar with the results found by [20,21] of 4.1 and 4.25 injuries per 1000 training hours, respectively. It can be observed that match injury incidence was notably higher than training injury incidence, which reflects common findings in the research, and can be explained by an increase of physical and mental demands during the match compared with training [2,15,22,23,25].

The mean time-loss due to injury was 25.6 ± 39.39 days, which was higher than reported by some studies, representing, on average, 14.6 days, 15 days, 18 days [2] and 19.7 days of time-loss [26] due to injury.

In respect to the injury severity, our data showed that 44% of the injuries had a moderate severity and 22% were severe injuries, corresponding to 1.39 injuries per 1000 exposition hours. The values concerning severe injury incidence were higher than those reported by Mallo et al. (2011) [22], of 0.4 severe injuries per 1000 exposition hours. While control group athletes showed a severe injury incidence of 3.55 injuries per 1000 exposition hours, none of the training group athletes suffered severe injuries, which can reflect the existence of a protective effect of neuromotor task prevention program.

	Control Group				Training Group			
	TTS X	TTS Y	TTS VR	Average	TTS X	TTS Y	TTS VR	Average
LFFL	9.1%	9.2%	8.8%	**9.0%**	52.8%	53.6%	53.0	**53.1%**
RFFL	4.3%	-7.3%	-2.5%	**-1.8%**	34.9%	50.3%	42.4%	**42.5%**
LFML	- 3.1%	-4.4%	4.3%	**-1.0%**	57.9%	62.2%	60%	**60.0%**
RFML	2.1%	0.5%	0.7%	**1.1%**	46.1%	49.6%	47.9%	**47.9%**
TOTAL	3.10%	-0.50%	2.83%	**1.83%**	47.93%	53.93%	50.83%	**50.9%**

TTS X – Time to Stabilization in medio-lateral axis (X)**TTS Y** –Time to Stabilization in antero-posterior axis (Y)**TTS VR**-Time to Stabilization((√X2+Y2)
LFFL - Left foot forward landing**RFFL** - Right foot forward landing **LFML**- Left foot medial landing
RFML - Right foot medial landing

Table 6: Average Percentage Variation of Time to Stabilization between O1 and O2.

	CG	TG
LFFL	15.2%	44.7%
RFFL	- 2.3%	56.6%
LFML	14.5%	34.4%
RFML	8.8%	44.3%
TOTAL	9.1%	45%

LFFL - Left foot forward landing**RFFL** - Right foot forward landing **LFML**- Left foot medial landing
RFML - Right foot medial landing

Table 7: IPF/ Body Weight Average Variation Percentage between O1 e O2.

1st week	2nd week	3rd week	4th week	5th and 6th week	7th and 8th week
40 cm jump double leg landing on the ground eyes open	40 cm jumpdouble leg landing on the foam pad (grade 1)eyes open	40 cm jump withdouble leg landing on the ground eyes closed	40 cm jump withdouble leg landing on the foam pad (grade 1)eyes closed	40 cm jump withsingle leg landing on the ground eyes open	40 cm jump withsingle leg landing on the foam pad(grade 1) eyes closed
Single leg stance on the groundeyes open	Single leg stance on foam pad (grade 1) eyes open	Single leg stance on foam pad (grade 2) eyes open	Single leg stance on foam pad (grade 3) eyes open	Single leg stance on foam pad (grade 3) eyes open	Single leg stance on foam pad (grade 3)eyes open and kicking a ball
Single leg stance on the groundeyes closed	Single leg stance on foam pad (grade 1) eyes closed	Single leg stance on foam pad (grade 2) eyes closed	Single leg stance on foam pad (grade 3) eyes- closed	Single leg stance on foam pad (grade 3) eyes closed	Single leg squat on foam pad (grade 1) eyes closed
Single leg squat on the ground	Single leg squat on foam pad (grade 1)	Single leg squat on foam pad (grade 2)	Single leg squat on foam pad (grade 3)	Single leg squat on foam pad (grade 1) eyes closed	Single leg squat on foam pad (grade 2)eyes closed
Step-down from 40 cm surface with a foam pad grade 1	Step-down from 40 cm surface with a foam pad grade 2	Step-down from 40 cm surface with a foam pad grade 3	Jumping from 40cm surface with double leg landing eyes open	Jumping from 40cm surface with double leg landing eyes closed	Jumping from 40cm surface with single leg landing in a foam pad (grade 1) eyes open
Heading the ball with single leg stance on the ground	Heading the ball with single leg stance on the ground	Heading the ball with single leg stance on a foam pad (grade 1)	Heading the ball with single leg stance on a foam pad (grade 2)	Heading the ball with single leg stance on a foam pad (grade 3)	Heading the ball with single leg stance on a foam pad (grade 3)
Passing the ball with single leg stance on the ground	Passing the ball with single leg stance on the ground	Passing the ball with single leg stance on on a foam pad (grade 1)	Passing the ball with single leg stance on on a foam pad (grade 2)	Passing the ball with single leg stance on on a foam pad (grade 3)	Passing the ball with single leg stance on on a foam pad (grade 3)
Single leg squat on the ground touching two objects at 50 cm distance	Single leg squat touching two objects at 75 cm distance	Single leg squaton a foam pad (grade 1) touching two objects at 50 cm distance	Single leg squaton a foam pad (grade 2) touching two objects at 50 cm distance	Single leg squaton a foam pad (grade 2) touching two objects at 75 cm distance	Single leg squaton a foam pad (grade 3) touching two objects at 75 cm distance
Single leg stance on the groundeyes open and application of multidireccionalexternal forces	Single leg stance on the groundeyes closed and application of multidireccionalexternal forces	Single leg stance on a foam pad (grade 1)eyes open and application of multidireccional external forces	Single leg stance on a foam pad (grade 1)eyes closed and application of multidireccional external forces	Single leg stance on a foam pad (grade 2)eyes open and application of multidireccional external forces	Single leg stance on a foam pad (grade 2)eyes closed and application of multidireccional external forces

Table 8: Neuromotor Exercise Program.

In this study, the three most common body parts injured were the ankle (25%), the knee (19.4%) and the thigh (16.7%), which is in agreement with the results reported by Mallo [22,24,26,27].

The most common types of injuries were ligament (33.3%), muscle injuries (27.8%) and contusions (11.2%), which is in agreement with previous studies produced by Carling [2,21,26,28].

Most of the injuries had a traumatic onset (91.7%) and only three injuries during the entire season were caused by overuse (8.3%). This value is smaller than reported by other studies, presenting values of 35% [25], 22% [26] and 20.0% [23].

Our data concerning the percentage of recurrent injuries (30.6%) attained a value corresponding to the superior limit of values reported by literature, which varies between 7% and 30.6% [29,20]. Other research reported a smaller percentage of recurrent injuries, between 11 and 12 % [26,29]. Nevertheless, it was observed a reduction of time-loss due to recurrent injuries in TG athletes comparing to CG (10.60 ± 8.68 days vs 32.00 ± 36.70 days), suggesting that the exercise program had a preventive effect.

Training Group vs Control Group in Injury Incidence and Time-loss

The total injury incidence of the CG in the 2012-13 seasons was 10.66 injuries per 1000 exposition hours, which was higher than the one observed in the TG, of about 4.1 injuries per 1000 exposition hours. Moreover, the mean time-loss due to injury in the CG was 33.25 ± 46.29 days and in the TG 10.42 ± 8.4 days.It can be concluded that mean time-loss was approximately 33% in the training group.

Postural Sway Analysis

In both evaluation moments, in unilateral stance with the eyes open, there were no statistically significant differences between TG and CG. Previous studies have reported no differences in static unilateral stance after an exercise program [31,32]. These studies only found differences when performing more dynamic and functional tasks. In our study, unilateral stance with the eyes closed showed statistically significant differences in the center of pressure displacement and sway area for TG athletes, between first and second evaluation, In the baseline evaluation moment (O1), the two groups did not present any significant differences and after the exercise program it was found that training group athletes decreased significantly the CP values, both in medio-lateral and antero-posterior axis and sway area. Furthermore, variability between TG athletes was lower after the exercise program. Given that the absence of visual information allows an objective evaluation of the somatosensory system effectiveness, these differences suggest an improved efficiency of preprogramming motor competences associated to a better motor control within the training group [13,33,34].

Furthermore, during the four jump tasks, we observed significant improvements in TTS (antero-posterior and medio-lateral axis and resultant vector) in the players from the TG, between the first and second moments of evaluation. No significant differences were found in the control group. These differences indicate an improvement of neuromuscular control in the training group athletes after a unilateral landing from a jump. There was a mean reduction of 50% in TTS in the training group from O1 to O2 (48% in antero-posterior direction, 54% in medio-lateral direction and 51% resultant vector), which can be associated with factors such as optimization of neuromotor processes and improvements in neuromuscular mechanisms [35,37]. These changes might reflect an improvement of afferent and efferent information integration from neuromotor system, which leads to an increase of postural stability [18,19].

Ross et al. (2009) [16] refers that the enhancement of neuromotor system ability in detecting and controlling the position of center of pressure leads to an improvement of postural reflex responses and, accordingly, to a decrease in time to stabilization. Taking into account that unilateral landing after a jump is a common injury mechanism; our exercise program seemed to be effective improving the dynamic articular stability of the TG athletes in this task.

Moreover, there was a reduction of about 45% in the initial peak force in the TG athletes and 9.1% in CG athletes, comparing O2 and O1. This suggests that the neuromotor exercise program induced a better absorption of impact forces after landing by improving neuromuscular control and reduction ligamentar and articular load, as reported by Irmischer et al. (2004) [38-42].

In our opinion, the integration of neuromotor tasks like eccentric movement control and landing on single leg with specific football movements help to explain the improvement of absorption of impact forces as well as time-to-stabilization after landing within athletes who performed the exercise program. Therefore, this may lead to a protective effect in the injury incidence and in the reduction in severity of the injuries in soccer players.

Limitations

This study was carried out with the players of only one football team, integrating a small sample. Furthermore, EMG and kinematic analysis were not included in the study. In the future we recommend to follow the methods of this study with a bigger sample and longer intervention period.

Conclusions

The application of our neuromotor reeducation program had positive effects on the mechanisms of postural control and reduction of injury incidence in amateur football male players. We recommend further investigation on specific interventions for preventing injuries during the first two months of the training season with a longer period of study and a greater sample.

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