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## ANALYSIS OF THE STATE OF HIGHLY SKILLED FOOTBALL PLAYERS' MUSCULOSKELETAL SYSTEM AT THE BEGINNING OF THE 2ND PREPARATORY PERIOD OF THE ANNUAL MACROCYCLE

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### Abstract

**Background.** Nowadays the development of adequate means of effective rehabilitation of athletes' organism after training and competitive load is becoming more and more an urgent task of sports training. It is well known that during training and competitive activity they can reach critical values. Thus, the optimization of the system of complex athletes' recovery is the basis for maintaining a high level of working capacity and preventing the negative consequences of overstrain during training and competitive loads. **Objective.** This research aims to determine the functional state of the musculoskeletal system (MSS) of highly qualified football players at the beginning of the 2nd preparatory period of the annual training cycle. **Methods.** Analysis of scientific and methodological literature, flexibility testing, stabilometry, methods of mathematical statistics. **Results.** It is established that at the beginning of the 2nd preparatory period of an annual preparation cycle the flexibility indicators' level of examined athletes were characterized as «low» or «below the average». It is shown that in this period of the annual macrocycle the high qualified football players' level of static ability to support corresponded to the value «average» and «below average», as well as joint mobility indicators. The facts of vestibular and proprioceptive disturbances were revealed. Such disturbances have a significant impact on the equilibrium function. **Conclusions.** According to the results of motor tests and goniometry, the low level of the functional state of the football players' MSS after the winter vacation indicates the inelasticity or shortening (spasm) of the muscles and ligamentous apparatus, which is one of the signs of their chronic overstrain. The previously obtained experimental data on the reduction of stabilometric parameters which characterize the stability of the vertical posture, instability of the joints of the lower extremities, the presence of vestibular and proprioceptive disturbances were confirmed by current research. Also our research expanded the views about preventive measures and leveling the negative effects of overload of highly qualified football players' MSS. It is recommended to include corrective and preventive exercises (myofascial relaxation(MFR) methods) in the preparatory and final parts of the training sessions. This technique will help to normalize the functional state of the MSS and to reduce the risk of injury.

**Key words:** football players, functional state, musculoskeletal system, flexibility, quality level.

Світлана Кокарева, Борис Кокарев, Едуард Дорошенко. Аналіз стану опорно-рухового апарату висококваліфікованих футболістів на початку 2-го підготовчого періоду річного макроциклу. *Актуальність.* Усе більш актуальним завданням спортивної підготовки сьогодення стає розробка адекватних засобів ефективного відновлення працездатності організму спортсменів після тренувальних і змагальних навантажень. Загальновідомо, що під час тренувань і змагальної діяльності вони можуть досягати критичних величин. Отже, оптимізація системи комплексного відновлення спортсменів є основою для збереження високого рівня працездатності й запобігання негативним наслідкам перенапруження під час тренувальних і змагальних навантажень. *Мета дослідження* – визначення функціонального стану опорно-рухового апарату (ОРА) висококваліфікованих футболістів на початку 2-го підготовчого періоду річного циклу підготовки. *Методи дослідження* – аналіз науково-методичної літератури, тестування гнучкості, стабілометрія, методи математичної статистики. *Результати роботи.* Установлено, що на початку 2-го підготовчого періоду річного циклу підготовки піддослідні спортсмени характеризувалися «низьким» або «нижчим від середнього» рівнем показників гнучкості. Показано, що у футболістів високої кваліфікації рівень статичної опороспроможності в цьому періоді річного макроциклу відповідав значенням «середнє» та «нижче від середнього», так само, як і показники суглобової рухливості. Виявлено факти вестибулярних і пропріоцептивних порушень, які суттєво впливають на функцію рівноваги. *Висновки.* Згідно з результатами рухових тестів та гоніометрії низький рівень функціонального стану ОРА футболістів після виходу із зимової відпустки свідчать про нееластичність або скороченість (спазмування) м'язів і зв'язкового апарату, що є однією з ознак їх хронічного перенапруження. Чинним дослідженням підтверджено раніше отримані експериментальні дані про зниження стабілометричних показників, що характеризують стабільність вертикальної пози, нестабільність суглобів нижніх кінцівок, наявність вестибулярних і пропріоцептивних порушень; розширено уявлення про заходи

попередження та нівелювання негативних наслідків перевантаження ОРА висококваліфікованих футболістів. Рекомендовано включати до підготовчої й завершальної частин навчально-тренувальних занять коригувальні та профілактичні вправи за наявними методиками міофасциального розслаблення (МФР), які сприятимуть нормалізації функціонального стану ОРА й зниженню ризику травматизму.

**Ключові слова:** футболісти, функціональний стан, опорно-руховий апарат, гнучкість, якісний рівень.

**Светлана Кокарева, Борис Кокарев, Эдуард Дорошенко. Анализ состояния опорно-двигательного аппарата высококвалифицированных футболистов в начале 2-го подготовительного периода годового макроцикла. Актуальность.** Все более актуальной задачей спортивной подготовки в настоящее время становится разработка адекватных средств эффективного восстановления работоспособности организма спортсменов после тренировочных и соревновательных нагрузок. Общеизвестно, что во время тренировок и соревновательной деятельности они могут достигать критических величин. Таким образом, оптимизация системы комплексного восстановления спортсменов является основой для сохранения высокого уровня работоспособности и предотвращения негативных последствий перенапряжения во время тренировочных и соревновательных нагрузок. **Цель исследования** – определение функционального состояния опорно-двигательного аппарата (ОДА) высококвалифицированных футболистов в начале 2-го подготовительного периода годового цикла подготовки. **Методы исследования.** Анализ научно-методической литературы, тестирование гибкости, стабилметрия, методы математической статистики. **Результаты работы.** Установлено, что в начале 2-го подготовительного периода годового цикла подготовки обследуемые спортсмены характеризовались «низким» или «ниже среднего» уровнем показателей гибкости. Показано, что у футболистов высокой квалификации уровень статической опороспособности в этом периоде годового макроцикла соответствовал значению «среднее» и «ниже среднего», также как и показатели суставной гибкости. Выявлены факты вестибулярных и проприоцептивных нарушений, которые существенно влияют на функцию равновесия. **Выводы.** Согласно результатам двигательных тестов и гониометрии низкий уровень функционального состояния ОДА футболистов после выхода из зимнего отпуска свидетельствует о неэластичности или укороченности (спазмировании) мышц и связочного аппарата, что является одним из признаков их хронического перенапряжения. Настоящим исследованием подтверждаются ранее полученные экспериментальные данные о снижении стабилметрических показателей, характеризующих стабильность вертикальной позы, нестабильность суставов нижних конечностей, наличие вестибулярных и проприоцептивных нарушений, расширены представления о мерах предупреждения и нивелирования негативных последствий перегрузки ОДА высококвалифицированных футболистов. Рекомендуется включать в подготовительную и заключительную части учебно-тренировочных занятий корректирующие и профилактические упражнения по существующим методикам миофасциального расслабления (МФР), которые будут способствовать нормализации функционального состояния ОДА и снижению риска травматизма.

**Ключевые слова:** футболисты, функциональное состояние, опорно-двигательный аппарат, гибкость, качественный уровень.

**Introduction.** Many researches related to modern issues of athletes' functional preparation show that sport of the highest achievements is characterized by sharp growth of volumes and intensity of training loads, high psycho-emotional intensity of training and competitive processes. This fact makes high demands on the organism of athletes, is also accompanied by significant functional changes, decreased working capacity and indicates the onset of obvious fatigue. In many cases one can see even the disruption of adaptive mechanisms [1; 4; 5].

The development of adequate means of effective recovery of the organism after training and competitive loads, which often reach critical values during training and competitive activity, is becoming an increasingly important task of sports training today. Optimization of the complex recovery system, which is aimed to improve the functional state of athletes, is the basis for maintaining a high level of working capacity and preventing the negative effects of overstrain [2; 8; 10].

The researchers conducted in the world over the last 15 years show an increase of sports micro-injuries as a result of chronic overstrain of the musculoskeletal system, especially in sports games. According to experts' assessments, football is the most traumatic one among these types [4; 6; 11].

A digital computer technology plays a significant role in sports practice of twenty-first century. One of these methods is computer stabilometry. It allows studying the deviations and other characteristics of the testee's common centre of gravity from the support area. This control technique is used to assess the kinetic stability of the organism of athletes and is a modern diagnostic tool for both normal and pathological conditions [3].

The systematic overload, the nervous system and MSS overstrain lead to disruption of the process of adaptation to physical activity, but increase the probability of injury and the occurrence of related diseases. The latter, in turn, occupy one of the leading places among the pathological conditions in athletes of various sports' types and specializations, permanently depriving them of the opportunity to fully train and to

participate in competitions. It is known from previous researches that the quality of «flexibility» depends on the functional state of the MSS. The flexibility indicators in the conditions of the MSS overstrain can significantly decrease; as a result this phenomenon leads to the muscle imbalance development [4; 5; 7].

In the case of team game sports, the control over the functional state of the MSS and timely prevention of overstrain allow introducing adjustments to the training process on time, as each athlete individually and the sports team as a whole. Thus, there is a real possibility to prevent the occurrence of more serious injuries which can permanently incapacitate athletes.

**Objective.** The aim of this research was to conduct an ascertaining experiment to determine the functional state of the musculoskeletal system of highly qualified football players at the beginning of the 2nd preparatory period of the annual training cycle.

**Materials and Methods.** Evaluation of the functional state of the MSS was carried out by testing the physical abilities associated with the manifestation of joint flexibility, goniometry and stabilometry. In this research, movability tests were used to assess the mobility of the joints of the lower extremities and spine. A number of simple tests such as: bending forward from a standing position, the bridge, the transverse and longitudinal (the best of 2 possible) twines, the test named «Tilting to the right (left) from a sitting position, legs apart were selected.» Evaluation of stabilometric parameters was carried out by the following indicators: total length of the path stabilometry (L stato-centigramme, mm), square stato-centigramme (s, mm<sup>2</sup>). For each of the considered parameters, the level of its development was determined according to the average group values with the determination of the arithmetic index and the arithmetic mean error ( $\bar{x} \pm S$ ). With the help of goniometry the mobility of the joints in angular units (degrees) was measured. The research was conducted on the basis of football club FC «Zarya» (Lugansk), Zaporizhzhya National University and municipal institution «Regional medical and sports clinic» of Zaporizhzhya Regional Council. It was attended by 22 football players of the first team aged 19–32 years old, who had complaints on pain in the MSS, decreased working capacity and general fatigue.

**Results.** As a result of the research of the flexibility level of the testees, it became obvious that most of the indicators have a level of «below average» («Bridge from the initial position lying on the back, cm»; «Full split, cm»; «Split on the left (right) leg, cm») or «average» («Tilt forward from the standing position, cm»; «Tilt to the right (left) from the sitting legs apart, cm»), (table. 1).

Table 1

**Indicators of Stabilometry and Flexibility tests of Highly Qualified Football Players at the Beginning of the 2st Preparatory Period of the Annual Macrocycle ( $\bar{X} \pm S$ )**

| The Studied Parameters  | Result       | Level of Development |
|---|--------------|----------------------|
| Bending forward from a standing position, cm                        | 5,93±2,05    | average              |
| Bridge from the starting position lying on the back, cm             | 69,44±3,41   | below the average    |
| Full split, cm  | 59,43±1,14   | below the average    |
| Split on the left (right) leg, cm                                   | 45,50±1,50   | below the average    |
| The tilt to the right (left) from a sitting position legs apart, cm | 6,35±0,11    | average              |
| The length of the stato-centigramme (L), mm                         | 523,33±13,31 | below the average    |
| The square of the stato-centigramme (S), mm <sup>2</sup>            | 407,27±43,81 | below the average    |

According to the results of stabilometry which was carried out immediately after the football players of FC «Zarya» (Lugansk) returned from winter vacations (which corresponded to the beginning of the 2nd preparatory period), the indicators of static ability to support of almost 50 % of the studied football players were on level of «below average».

At the same time, in almost 60 % of cases the indicators of stability of the vertical posture were «below average». This indicates a deterioration of the equilibrium function. The shift of the reverse projection of the general center of mass (GMC) in the frontal and sagittal planes was lower than the «average level» in more

than 65 % of the examined football players. More than 34 % of these sportsmen have the CMR projection in the sagittal plane shifted forward, and 12 % – shifted back. The displacement of the CMR projection in the frontal plane and to the right (left) was also observed in almost 12 % of the testees.

This study revealed that the area of the stato-centigramme in almost 64% of examined football players corresponded to the quality levels «average» and «below average». The average index of this indicator was  $407,27 \pm 43,81 \text{ mm}^2$ , and the average index of the parameter «length of the stato-kinesiogram» slightly exceeded the indicators, responding to the «average» level of the indicator in less than 36 % of football players ( $523,33 \pm 13,31 \text{ mm}$ ).

During the analysis of the data of lower extremities joints' goniometry of the testees one found out that the indicators of joint mobility in football players were also on the level «average» and «below average» (table 2).

Table 2

**Indicators of Goniometry of Highly Qualified Football Players at the Beginning  
of the 2nd Preparatory Period of the Annual Macrocycle, ( $\bar{x} \pm S$ , Degrees)**

| Joint       |         | Flexion     |     | Extension |   | Abduction  |     |
|-------------|---------|-------------|-----|-----------|---|------------|-----|
| Coxofemoral | Right   | 115,05±2,55 | a   | -         | - | 44,43±1,17 | a   |
|             | Leftist | 114,63±2,01 | a   | -         | - | 43,68±0,92 | b/a |
| Knee        | Right   | 126,73±1,77 | a   | -         | - | -          | -   |
|             | Leftist | 127,80±1,27 | a   | -         | - | -          | -   |
| Talocrural  | Right   | 33,53±1,83  | b/a | 7,14±0,84 | a | -          | -   |
|             | Leftist | 34,86±1,70  | b/a | 8,28±0,89 | a | -          | -   |

Notes: a – «average»; b/a – «below the average».

**Discussion.** From our point of view, such low results of flexibility parameters of examined sportsmen can be explained as follows. First: it is well known that flexibility is a physical quality of antagonistic orientation in relation to strength ones. Secondly: highly qualified football players have a very high level of development of strength abilities, which has been repeatedly proved by many previous scientific studies [1, 3, 7, 11]. In addition, they proved that it is flexibility that determines the functional state of the MSS.

In our opinion, the low results of testing of all abovementioned indicators of joint flexibility, goniometry and stabilometry are due to the fact that the football players returned to training work after a very long winter vacation after the end of the first competition period. This is the first round of the football championship of the Ukrainian Premier League. Also peculiarities of the calendar planning of the upcoming competition period have a great impact on decreasing of studied parameters.

Thus, summarizing the results and comparing them with the data of previous studies, a new strategic direction of work on the development of joint flexibility of highly qualified football players and restoration of the state of their musculoskeletal system was chosen. That's why, it seems relevant to develop individual components of personal programs and group (team) model of recovery measures using innovative techniques of myofascial relaxation [9], as a means, firstly, of muscle stretching and, secondly, the recovery after high physical activity to prevent injuries of the musculoskeletal system. Such damages can appear due to the lack of elasticity of the myofascial structures of highly qualified football players' organism. It should also be noted that one of the hypotheses of both the current and the next experiments is the idea that the methods of physical training chosen by us and rehabilitation of football players after high muscle loads will allow to bring the studied indicators to a new, higher quality level, to keep the necessary conditions for a long time during two competitive periods of the annual cycle of training, and thereby contribute to the high final result of competitive activity of athletes.

**Conclusions.** Thus, we consider it is possible to draw the following conclusions:

1. According to the results of mobility tests and goniometry, the low level of the functional state of the MSS indicates the inelasticity or shortening of the muscles and ligamentous apparatus, which, in turn, is one of the signs of chronic overstrain of the MSS and leads to a decrease of working capacity, threatens great physical and mental overload against the background of insufficient recovery and can cause serious injuries and diseases, permanently incapacitate athletes.

2. After the return from the winter vacation, before the beginning of the 2nd preparatory period, there was a decrease in stabilometric indicators in general and, in particular, the values of indicators which characterize the stability of the vertical posture. This fact may indicate individual disorders of the MSS, instability of the joints of the lower extremities, the presence of vestibular and pro-perceptive disorders.

3. It is recommended to the football players to include corrective and preventive exercises in the training process in addition to the usual pre-stretching («pre-stretching»). That will help to normalize the functional state of the MSS and to reduce the risk of injury.

Prospects for further research. The next stage of our research will be the development of individual components of personal programs and group (team) model of recovery activities using innovative techniques of myofascial relaxation and their place in the structure of the training process of highly qualified football players.

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