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The influence of 12 weeks application of dynamic and static stretching on the range of joint mobility for the group of soccer players

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Abstract

Background & Study Aim: The optimal level of flexibility helps to streamline the movement, thereby becoming one of the important components of sports performance. The aim of this study is the effect of six weeks applications of dynamic and static stretching on active mobility of the hip joint in selected soccer players.

Material & Methods: To obtain the data used a stretching program developer focusing on dynamic or static stretching. Two selected male soccer player groups were during the intervention period of six weeks evaluated for changes in the range of joint mobility. Static stretching program we applied to the players (aged 19-30 years) of *TJ Krupka* three times a week in the final part of the training unit for six weeks. Dynamic stretching program was applied to players (agend 18-29 years) *TJ Česká Lípa* three times a week twelve minutes in the warm up of the training unit for six weeks. Active mobility of the hip joint – flexion and extension of both legs was evaluated before and after the stretching program.

Results: Statistically significant differences in the active range of motion when exposed to static and dynamic stretching with dominant and non-dominant leg. Motion interventions using dynamic stretching has proven significantly more effective for the dominant limb and with the non-dominant lower limb, rather than static stretching method.

Conclusions: Static stretching program has proven suitable for use in the final part of the training unit, which is used for general calming of the body and the release of a muscle tension. Dynamic stretching program, by contrast, proved to be suitable for inclusion in the warm-up of the training unit. In terms of increasing the range of motion in the monitored joint-muscular unit, the dynamic stretching during prolonged application proved more effective than using static stretching. Therefore, we recommend such a methodology.

Keywords: flexibility • range of motion • stretching program

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Soccer – *noun* US same as football [20].

Player – *noun* someone taking part in a sport or **game** [20].

Dominant – *adjective* important or powerful [20].

Flexibility – *noun* **1.** the amount or extent to which something can be bent **2.** the extent to which something can change or respond to a variety of conditions or situations flexibility training [20].

Flexibility training – *noun* regular exercise that increases the body's flexibility, e.g. yoga or Pilates [20].

Joint – *noun* a part of the body where two bones meet [20].

Mobility – *noun* the ability to move about [20].

Mobility training – *noun* exercises that increase the range of movement of the joints [20].

Static stretching – *noun* stretching in which a position that stretches a muscle is assumed and then held [20].

Static stretching – *noun* stretching in which a position that stretches a muscle is assumed and then held [20].

Strength – *noun* the fact of being strong [20].

Strength training – strength training nountraining that aims to build muscle strength, usually resistance training [20].

Stretch – *verb* to pull something out, or make something longer; *noun* **1.** the straight-ening and extending of a part of the body, e.g. as an exercise **2.** the straight part of a race-course, especially the final section approaching the finishing line [20].

Dynamic stretching – *noun* stretching that involves some movement but does not force the muscle past its range of motion [20].

Static active stretch – *noun* same asa ctive stretch [20].

Muscle strength – essential and basic physical capacity in combat sports by which the body moving status is modified [21].

ROM – *abbreviation* range of motion [20].

Introduction

The optimal level of flexibility helps to streamline the movement, thereby becoming one of the important components of sports performance. It is also a prerequisite for the proper and efficient execution of movement, delaying the onset of fatigue and helps to develop speed, strength, agility and endurance. Systematic stretching exercise reduces the risk of injury and improves performance by reducing the resistence of the structural tissues surrounding the joint, thus allowing a greater range of motion. Kirkendall [1] states that stretching is one of the important components of training in soccer because of the optimal development of joint mobility and it also acts as a prevention against shortening of the hamstrings. Marquez et al. [2] in their research confirm that for improving joint mobility is sufficient frequency of static stretching three times a week. Mosler [3] referring to the well-documented empirical data [4, 5] underlines that the static and dynamic flexibility has an influence on muscle balance, potential maximal strength and possible speed and also smoothness of movement.

The most common techniques used in practice are the methods of static stretching and PNF techniques (proprioceptive neuromuscular facilitation). The main benefits that these technologies offer, are the gentleness and easy training and acquisition of motion.

We place dynamic stretching at the beginning of the training unit to a warm up phase, this section will focus on the preparation of the musculoskeletal system for load and activation of motor units. Professional studies in Gelen [6] and Zois et al. [7] suggest that dynamic stretching has a positive effect on athletic performance, particularly of the power and speed character. In contrast when doing static stretching occurs due to stretching the reduction of the stiffness of muscle-tendon unit or reduction of activating the motor units. Static stretching included in the introductory part of the training unit composed of dynamic movements is counterproductive. This method of stretching should be applied at the end of training as a way of calming the body and relax the muscles after exercise in Kallerud and Gleeson [8]. Rosembaum and Hennig [9] concluded in their study that it is not only suitable to apply static stretching stereotypes as their potential adverse effect on muscle performance is not ruled out.

The aim of this study is the effect of six weeks applications of dynamic and static stretching on active mobility of the hip joint in selected soccer players.

Material and methods

Participants

The research group to which we applied static stretching program was composed of 19 probands. The group included male soccer players from *TJ Krupka* (Czech Republic), age was 19 to 30 years. Dynamic stretching program was conducted by 20 male soccer players from *TJ Česká Lípa* team, aged 18 to 29 years. Both groups of examined probands (deliberately chosen by us) coincide in almost all variables (Table 1).

Table 1. Age and general somatic characteristics both experimental groups of socer players (average and standard deviation).

Variable	Static stretching group (n = 19)	Dynamic stretching group (n = 20)
age (years)	23.10	23.20
weight (kg)	74.95	79.70
height (m)	1.78	1.80
BMI	23.65	24.49

Design of the study

The socer players were tested during the autumn part of the football season. Dominant leg being for all tested subjects the right one. Research participants during the testing were not involved in another intervention motion program. Based on execution of Thomayer's exam none of the probands showed signs of hypermobility, which is contraindicated for the development of joint mobility. All participants were healthy and in the past they haven't had an injury or a surgery of the musculoskeletal system. Probands trained three times a week and once a week they played the championship match. The entire group consisted of athletes at amateur level. All persons have signed a written informative agreement.

The study was approved by the ethics committee for research at the *University of J.E. Purkyně in Ústí nad Labem* under reference number 4/2016/01, and was performed in accordance with recognized ethical standards and legislation.

Assessment of flexibility

The research method was a diagnosis of active range of motion in the hip joint flexion and extension in degrees. Gradually, each player lay on the prepared bed, which was 80 cm high. On the body of the probands, to be exact on both lower limbs at *trochanter major*, control *lateral femoral* and *iliac crest*, were

gradually affixed markers – reflective elastic straps. After a thorough briefing individuals conducted assigned exercises.

Flexion of the hip was performed from a basic position of lying with knees bent – non-dominant leg stretched, upper limbs cross-fixed on the shoulders. Fixation of pelvis was ensured by an instruction to a probands to consciously hold the iliac bone on the tested side to the mat to avoid tipping backward and not create a lumbar kyphosis. Proband raised the dominant limb in smooth motion forward, without any deviations to the extreme position. The same movement subsequently repeated with a non-dominant leg.

Extension of the hip was performed from a basic position of lying on the stomach – both legs stretched, upper limbs cross-fixed under the head. Fixation of pelvis was ensure by an instruction to a proband to consciously hold the *iliac bone* on tested side to the mat. Proband performed a continuous movement of the dominant leg and extended backwards, without any deviations to the extreme position. The same movement subsequently repeated with a non-dominant leg.

The exercises were shot on a digital camera (multiformat AVCHD camcorder Panasonic AG-HMC 41 with a frame speed of 50 frames / sec and writing 720/50 P) for future evaluation of the degree of mobility. In each test was the center of the camera lens always at a height of 115 cm and 230 cm away from the measured person. Then a video was filmed that recorded the difference in the angles of the start and end position. Individual recordings were subsequently evaluated using a software program Dartfish Team Pro Data and then the data was recorded. Size of the final angle was regarded as the difference between an angle in the maximum range of motion achieved in extreme position and angle in the basic position of the proband.

Experimental protocol

Probands were deliberately divided into two experimental groups, one group underwent a six weeks intervention program focused on static stretching and the second group performed the same period of dynamic stretching program. Intervention took place in training units within the soccer team three times a week for six weeks. In a research group focused on static stretching exercises were carried out in the final part of the training unit, in the second experimental group was dynamic stretching included in the introductory part of the training unit. Before and after the application of the stretching program, the active range of motion of the hip joint was evaluated in the way, described above.

For testing and assembly of both stretching programs have been used selected exercises for the lower extremities of the book: Alter MJ. *Strečink: 311 protahovacích cviků pro 41 sportů* [10] (Stretching: 311 stretches for 41 sports).

For static stretching ten exercises were conducted aimed at stretching various muscle-joint units in the legs – hamstrings, with a hold in an extreme position from ten to twenty seconds. Hold time and a degree of muscle tension adapts to the individual character of the proband. When exercising, these principles should be followed – non-violence, non-painfulness, pleasant feeling with the loss of tension.

Ten exercises were included in the dynamic stretching program, which are carried out with a guided motion without holding in the extreme position. Motion is repeated several times and the maximum joint range should not be achieved. Every exercise is carried from fifteen to twenty times.

Each exercise was performed for the dominant leg, followed by an of exchange legs. Followed by a smooth transition to the next exercise.

In a research experiment, we focused on assessing the impact of different kinds of stretching on changes in the scope of joint mobility. In the final section of work we were observed differences between the observed values using intervention static stretching during flexion and extension of the hip joint. Subsequently, attention was focused on verifying the difference of using intervention of dynamic stretching.

Statistical analyses

All statistical tests were performed using Statistica 6.1 Anthropometric characteristics and differences after application of the program were compared between groups using the Student *t*-test for independent samples. For all calculations, we chose the significance level minimum $p<0.05$.

Results

The results of the evaluation of the hip flexion indicates a statistically significant difference in the size

Motor safety is consciousness of the person undertaking to solve a motor task or consciousness the subject who has the right to encourage and even enforce from this person that would perform the motor activity, who is able to do it without the risk of the loss of life, injuries or other adverse health effects [22].

Effort safety is consciousness of the person who starts physical effort or consciousness of the subject who has the right to encourage or even enforce from this person the physical effort of a certain intensity and duration, who it is able to do so without risking life or health [22].

Non-apparatus test – that motoric test (exercise endurance test) of the required reliability (accurate and reliable), which use does not require even the simplest instruments [23].

Quasi-apparatus test – can be conducted with simple instruments (a stopwatch, a ruler, a measuring tape, etc.) [23].

of the resulting angle before and after the intervention of static stretching at the dominant lower limb ($p = 0.000389$, $\omega^2 = 0.48541$). A statistically significant difference was not confirmed to us between the first and second measurements with the non-dominant lower limb ($p = 0.100853$, $\omega^2 = 0.09493$). When applying dynamic stretching were statistically significant differences in the size of the resulting angle between the observed values with the dominant lower limb ($p = 0.000046$, $\omega^2 = 0.57$) and non-dominant lower limb ($p = 0.000178$, $\omega^2 = 0.51$) (Table 2).

The results of the evaluation of the extension of the hip show a statistically significant difference in the size of the resulting angle before and after the intervention of static stretching for the dominant lower limb ($p = 0.00038$, $\omega^2 = 0.95804$) and the non-dominant lower limb ($p = 0.000498$, $\omega^2 = 0.47065$). When applying dynamic stretching were statistically significant differences in the size of the resulting angle between the observed values for the dominant lower limb ($p = 0.000051$, $\omega^2 = 0.57$) and the non-dominant lower limb ($p = 0.00013$, $\omega^2 = 0.62$) (Table 3).

Discussion

Results of the study show that after application of our proposed stretching program development of flexibility has occurred in both of the test groups. With the significance level of $p<0.05$ differences between the angles before and after intervention stretching program were demonstrated, both in the group applying static stretching and in the group applying dynamic stretching. The results of this study show that when exposed to static and dynamic stretching ROM increased to a similar extent as in the results of studies by Gonzalez-Rave et al. [11] or Behm et al. [12]. At the same time, however, when comparing the results of static and dynamic stretching, dynamic stretches seem to be more effective, similar results were achiever by Amiri-Khorasani and Kellis [13] in their study.

In our study, we used two stretching techniques: static and dynamic stretching. Static stretching is characterized by progressive muscle strain to the extreme position, followed by holding in the extreme position (20-30s). Little and Williams [14] tested the effectiveness of static and dynamic warm-up with a group of professional soccer players. Their research can say that dynamic stretching is in terms of speed capabilities more effective. Furthermore, in their study they mention that static stretching does not offer the expected benefit of preventing injuries, reduces performance in vertical jumps, short sprints, maximum muscle contraction and muscle strength, negatively affects coordination, reduces the body's ability to respond quickly to new stimuli and remain in a certain load. The aforementioned prerequisites, however, are very important in soccer. Preferable method for preparing the organism for stress then becomes dynamic stretching, which is composed of basic functional exercises preparing organism for specific motions and the performance itself. These exercises

Table 2. Differences in range of motion in flexion of the hip joint before and after the intervention of static (n = 19) and dynamic (n = 20) stretching for dominant and non-dominant leg of socer players.

Variable	Before I	SD	After I	SD	*t*	p	ω^2
SS (D)	47.66	8.296	49.92	8.37	−4.345	**0.00038***	0.48
SS (N)	45.80	9.74	47.28	10.77	−1.72	0.10085	0.09
DS (D)	46.41	8.12	49.15	6.59	−5.248	**0.00004***	0.57
DS (N)	46.24	9.64	49.15	8.41	−4.642	**0.00017***	0.51

SS (**D**) static stretching for dominant lower limb; **SS** (**N**) static stretching for non-dominant lower limb; **DS** (**D**) dynamic stretching for dominant lower limb; **DS** (**N**) dynamic stretching for non-dominant lower limb; **I** intervention of static or dynamic stretching; **SD** standard deviation; ***t*** value of ***t***-test; **p**: statistical signifikance; **ω^2**: effect size value; * minimum $p<0.05$

Table 3. Differences in range of motion in extension of the hip joint before and after the intervention of static (n = 19) and dynamic (n = 20) stretching for dominant and non-dominant lower limb of socer players.

Variable	Before I	SD	After I	SD	*t*	p	ω^2
SS (D)	11.28	3.89	13.21	3.29	−5.413	**0.00004***	0.95804
SS (N)	10.57	8.29	12.28	8.37	−4.234	**0.00049***	0.47065
DS (D)	13.00	2.62	15.09	1.26	−5.199	**0.00005***	0.57
DS (N)	10.92	2.10	13.70	1.26	−5.835	0.00013	0.62

SS (**D**) static stretching for dominant lower limb; **SS** (**N**) static stretching for non-dominant lower limb; **DS** (**D**) dynamic stretching for dominant lower limb; **DS** (**N**): dynamic stretching for non-dominant lower limb; **I** intervention of static or dynamic stretching; **SD** standard deviation; ***t*** value of *t*-test; **p** statistical signifikance; ω^2: effect size value; * minimum p<0.05

use specific kinds of movements of the given sports sector, burden greater number of muscles and gradually increase the range and speed of movement. In dynamic stretching there should be no swing, vibration or jerky movements.

Regardless of the stretching program important issue is the ongoing control effects. Mosler [3, 15] verified the usefulness of the recommended non-apparatus and qusi-apparatus flexibility tests. Combining knowledge about the effects of training (not only on our research), methods and tools useful in the current control has a direct relationship to the motor and endurece safety. On the one hand, any recommendations on broadly defined methods and training effects seemingly distant sports and physical activities are universally applicable [16-19]. On the other – approach to sports training primarily as an attractive form of mental and physical activity brings the mission to sports on health education.

Conclusions

Given the above data in our study, we concluded that the application of static stretching program in the final part of the training unit, and applications of dynamic stretching program within the initial warming leads to a significant improvement in joint mobility.

Static stretching program has proven suitable for use in the final part of the training unit, which is used for general calming of the body and the release of a muscle tension. Dynamic stretching program, by contrast, proved to be suitable for inclusion in the warm-up of the training unit. In terms of increasing the range of motion in the monitored joint-muscular unit, the dynamic stretching during prolonged application proved more effective than using static stretching. Therefore, we recommend such a methodology.

In our study, we must not forget the significant factors influencing the measurements, such as room temperature, time of day, age of individuals, fatigue and type of physical activity performed. It is always necessary to respect the physiological mechanisms in the body and comply with them during physical exercises.

Competing interests

The authors declare that they have no competing interests.

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