EXERCISES BASED ON NEUROPLASTICITY PRINCIPLES INCREASE MOBILITY IN ELITE SENIOR FOOTBALL PLAYERS

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Abstract

To achieve adequate range of movement in joints is an important determinant of training status in football. It enables a biomechanically correct performance of certain movement structures and contributes to the prevention of sports injuries. The Feldenkrais method offers the possibility of learning and optimization of movement, which, consequently, through inhibition of redundant muscular activity may enable an increase in the range of movement (ROM). Previous studies have shown contradictory results on the influence of Feldenkrais method on increase of ROM. The goal of this research has been to compare and quantify the influence of work according to Feldenkrais method and classic stretching exercises on ROM in top-level football players. Subjects were randomly placed into 3 groups: Group I practiced Feldenkrais method and had an average initial value of Reach 1=0.57±11.4 cm, and of final Reach 2=6.1±10 cm; Group II practiced stretching exercises and achieved an average initial value of Reach 1=5.1±3.1 cm, while the final Reach was 2=6.9±3.3 cm; and the Control group (Group III) had an average initial value of Reach 1=3.9±4.3 cm, and the final value of Reach 2=5.1±4 cm.

Key words: *Feldenkrais method, football, neurophysiology, 3D kinematics, stretching*

Introduction

Football is a complex sports game including a large number of different movements, which by its integration makes what is called a football skill (Andrzejewski et al., 2013). Among other characteristics, skill is described as a quality of movement. It can be judged from the perspective of biomechanical performance of a certain element, and also through interrelationship of stability and mobility of particular body segments of importance for this element. Freedom of movement is the prerequisite for efficient transfer of forces through the skeleton, which may represent a basis for good biomechanical performance. Mobility, i.e. the range of movement, often identifies with flexibility, both in diagnostics and in the training procedures (Knudson, 2007). Therefore, an established praxis for increasing the range of movement in football players often is a training of passive and active stretching. This kind of approach, however, does not usually produce long-term results. The explanation for this phenomenon might be that the cause for shortened muscle may be in the nervous system action, i.e in motor programs. The information coming from the neural system is the one that activates or inhibits a muscle. The phenomenon found most often in bad organization of movement is redundancy of muscular activity and development of motorics through inhibition. Feldenkrais method by its approach to learning through awakening, direction of attention, and slow performance offers a basis for corresponding changes. (Feldenkrais, 1990).

Chinn at al. (1994) researched the effects of one Feldenkrais intervention on 23 examinees divided into two groups. The experiment was quantified by the level of perceived exertion and by the hook-lying functional reach task, noted pre and post-treatment. The group that practiced Feldenkrais significantly improved in the perceived exertion but not in the reach task, while the group that practiced sham Feldenkrais treatment did not improve in both tasks. James et al. (1998) researched 48 students, divided into 3 groups: Feldenkrais, relaxation, and control group. The Active knee extension test was performed prior to the first session, prior to the forth and after the final session of intervention. There were no significant differences between groups in the hamstring length. Hopper et al. (1999) investigated the influence of Feldenkrais method on 79 healthy examinees allocated into two groups: Feldenkrais and control group. Flexibility was estimated by the Sit&Reach test, perceived exertion by Borg's scale and hamstring length by the Active knee extension test. After one lesson examinees were tested again. The Feldenkrais group significantly improved flexibility and no significant differences were found in the perceived exertion or hamstring length. Dunn and Rogers (2000) investigated the effect of the Feldenkrais method on only one side, and then compared two sides of the body. The study included 12 examinees (age 18-28 yrs) who made the Sit&Reach test before and after intervention. 10 of them reported better sensation on one side, for 8 the second test was indeed better on that side. Stephens et al. (2006) researched 33 examinees who were assigned randomly into two groups: Feldenkrais and control group. The experimental group practiced for 3 weeks. The hamstring length was measured by using the Active knee extension test, before and after the intervention. The experimental group showed significantly better results compared to the control group.

Functionally and neurophysiologically speaking, mobility can be linked to balance i.e. reliable support. A timely inclusion of agonists and exclusion of antagonists in motion - reciprocal inhibition is also important (Knudson, 2013; Hall, 2016). The muscle activity can be activated at will, as well as unintentionally due to variously acquired habits.

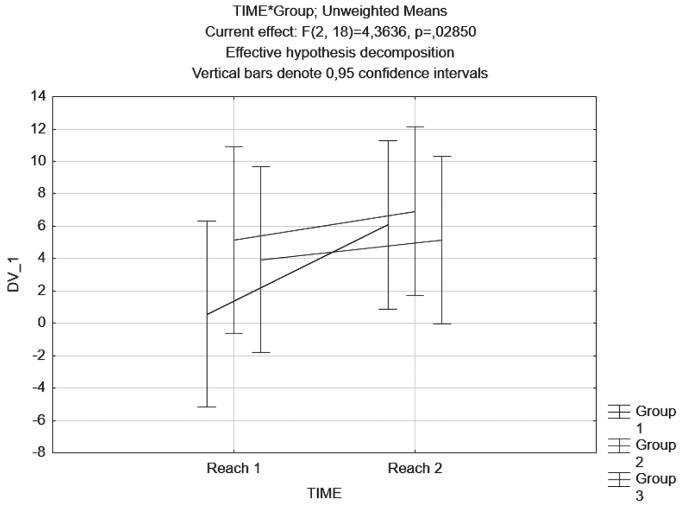
By releasing excess effort, with ease and greater clarity, the ideal position of stability can be reached. (Feldenkrais, 1987). When using this method the choice and precise execution of exercises is crucial. This can also be the reason not much research has been done in this area, and when it was done, results were often conflicting. Hence, it was decided research of the effects on the influence of mobility of kinesthetic training of the Feldenkrais method (1.) compared to the classical stretching method (2.) in a controlled group (3.) would be conducted.

Methods

Research was carried out in May of 2016 at Football club Dinamo Sports Center. The sample comprised of 21 examinees, professional football players of the highest Croatian national rank, age 20.95 ± 4.48 yrs, height 183.00 ± 6.93 cm and of the body mass of 77.93 ± 7.63 kg. All examinees initially partook in the Stand & Reach test (S&R) with a delay of 2 seconds, which was necessary in order to disconnect the influence of the myotatic reflex (stretch reflex) and thus enable the examiner to read the number on the scale (Reach 1) (Hall, 2016; Knudson, 2007). Examinees were then randomly divided into 3 groups with 7 examinees in each group. Group I used the Feldenkrais method (FM) which comprised of 8 variations of the exercise "The Pelvic Walk". Each exercise was performed about 20 times, in a research rather than a repetitive manner, but in search of an easier option of movement. Group II conducted standard stretching exercises (12 in 2 series, holding for 30 seconds). Group III was the control group, meaning the examinees did not partake in any protocol. After 15 minutes of the commencement of a certain protocol, all 3 groups repeated the S&R test and results were measured (Reach 2). The performance of the tests (the initial and final one) were taped with a GoPro 4 Hero camera mounted sideways under an angle of 90 degrees in relation to the examinee, with a sampling frequency of 60 Hz. The video was processed by the Ariel Performance Analysis System (APAS) a program for kinematic analysis. Angles between 4 points of the Modified Dempster model were observed (Dempster, 1955), tip of the toe (TOE), ankle (ANK), knee (KNEE), hip (TROH) and shoulder (ACR). During the implementation of the S&R test examinees were standing on a zebris platform (ZEBRIS) by which the ratio of the pressure between the front and back of the foot was monitored. Parameters were synchronized and processed in the same time unit. The gathered results were registered and processed by software package Statistica 12, licencened by the Faculty of Kinesiology, University of Zagreb. By using the Shapiro-Wilk test normal distribution was checked. On the reach results in the initial testing (Reach 1) statistical method ANOVA was used with the goal to check the non-existence of statistical relevance of differences between 3 groups of examinees before the experiment was carried out. The homogeneity of the distribution of the results for the first and second testing (Reach 1 and Reach 2) was checked by the Levene's test. The existence and importance of differences between the initial and final tests including groups was tested by ANOVA for repeat testing, after which the Post Hoc Tukey HSD was used to analyze within groups where significant differences in the Reach test results between the first and second testing were detected. A significant difference was only found in Group I, the t-test was then used for dependent samples on the kinematic and kinetic variables to determine the space differences in performances.

Results

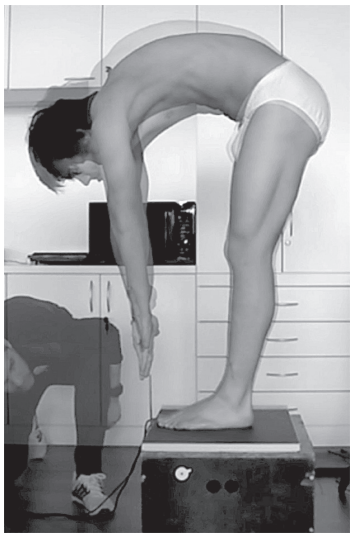
The normality of the distribution of results reached on the initial reach measurement (Reach 1) was checked and verified by the Shapiro-Wilk test value of $W=0.92$, for $p>0.05$. Hence, it was decided the parametric method would be used in the further analysis of results. The use of statistical method ANOVA checked and verified the non-existence of statistical relevance of differences between 3 randomly chosen groups of examinees, value of $F=0.75$ with the possibility of error $p<0.05$. The Levene test determined homogeneity of the distribution of test results Reach 1 and Reach 2, value of $F(\text{Reach 1})=6.6$, $F(\text{Reach 2})=11.2$, and everything for $p<0.05$. ANOVA method indicated a significant difference in results for repeat testing of the time point component between the initial and final testing, value of $F=19.4$ for $p<0.05$. In the combination of time and group component, a significant statistical difference between the 2 tests was determined, value of $F=4.4$ for $p<0.05$. Guided by previous results, the Post Hoc Tukey HSD test was used for the time and group component where the existence of a significant difference was detected between the first and second testing but only for Group I, value of $F=0.0014$ for $p<0.05$. Considering the positive changes in Group I, the t-test for dependent samples was used to analyze whether there was a difference in the kinematic and kinetic variable that describes the method of performing the test. Although it was determined the greatest difference of the average value was in the angles of the hip and shoulders, only the angle of the shoulders was statistically significantly higher in the final measurement. The average value of the initial results were 108±15 degrees of the final measurement which was 113±13 degrees, $t=-3.03$ for $p<0.05$. The average value and the trend of the initial and final results for all 3 groups can be seen in Graph 1. Group I had the average initial value of Reach 1=0.57±11.4 cm, and in the final value of Reach 2=6.1±10 cm. Group II had the initial average value of Reach 1=5.1±3.1 cm, while the final value of Reach 2=6.9±3.3 cm. Group III had the average initial value of Reach 1=3.9±4.3 cm, and the final value of Reach 2=5.1±4 cm.



Graph 1: Average values of S&R tests (Reach 1 and Reach 2) in two different time points for each of three groups.

Discussion and conclusions

All 3 groups on an average had better results in the final measurement, however, only the results of Group I (FM) were statistically significant and therefore the most important. The result might be due to the fact that Group I had very low values in the initial measurement, with two very poor results. The positive changes in the results of Group I were shown through a significant increase in the angle of the shoulder joint, although there were differences in the angles of the other joints. The assumption is that the examinees developed different strategies for a better reach in the final testing. Group II (stretching) on an average also made a positive shift but not statistically significant. Group III was also average, but not significantly, it was better in the second measurement, which was coincidently at its lowest. The interpretation can be linked to learning and adjusting to the test. Focus on the test can often be aimed at flexibility of the muscles of the hamstrings and the lower part of the spine. However, it should be pointed out that it is to do with the entire kinetic chain – from the points of support, distribution of weight and mobility of the pelvis against the knee joint up to the adaptation of the spine for arm extensions. In conclusion the Feldenkrais method of exercise enhances function with movement development, enables better biomechanics of movement meaning it gives better support to the skeletal musculature as well as a more efficient synergy of muscle activities (Picture 1). Owing to the biomechanically better executed movement, excess muscle activity disappears, while mobility and motoric control of movement increases (Feldenkrais, 1987). Feldenkrais method offers variability for a greater number of movement options for ankles, hips, spine and shoulders. Further research should explore the effects of prolonged use of this protocol on a larger sample and on more diverse types of examinees. Feldenkrais method doesn't affect everyone equally hence the kinesthetic aspect of performing exercises should be introduced into the training process with the goal of achieving real function of movement which indirectly influences stability and mobility and as a result prevents injuries.



Picture 1: Example of one player, before and after application of Feldenkrais method.

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