

The influence of strength training on lower limb power, locomotive speed and jumping ability of football players

Summary

Actions of contemporary football players on a pitch are characterized by the growing dynamics in kinetic, technical and tactical aspects (Grycmann and Szyngiera, 2017). Short-term actions and their amount when they are made with the maximum (sprints with a ball or without a ball) and high intensity (for example, counter-attack) during football matches are of great importance in contemporary football (Chmura, 2001; Andrzejewski et al., 2015). Therefore, speed and strength preparation are important in football where explosive kinetic activities dominate, and its high level determines victory.

Professional planning, contemporary training methods, knowledge and objective evaluation of how well a player is trained are the starting point to win the championship (Ljach and Witkowski, 2004). Skills of players are the main indicator of a football team level – a sum of these skills makes a team's position and shows its class. The higher they are, the higher the game level is (Smolarz, Napierała and Cieślicka, 2013). An appropriate kinetic preparation (the high level of strength and muscle power) increases safety of a game and can minimize a chance a player will be hurted (Widuchowski J. and Widuchowski W. 2005; Garlicki et al., 2006; Korpanty et al., 2017).

The growing level of requirements set in football makes many trainers expect that objective criteria for evaluating how skillful a player is will be worked out. These criteria enable comparing achieved results to standard values and defining the number of deviations in measuring units. The optimizing of a training, including research methods, is a result of growing demands regarding kinetic preparation in football. New, tested research methods can influence the increase of kinetic abilities efficiency.

An ability of a player to generate the greatest power is considered a factor which determines success in sports (including football) which require an optimal relations between strength and speed (Baker i Newton, 2005; Argus, Nicholas, Keogh, Hopkins, 2013). In football, muscle power of lower limbs displays in almost each element of a game (for example, speed up, braking, ball handling, ball passing and receiving, shot, tackle, dribble). In relation to the above-mentioned, the principal element of football is forming an appropriate level of muscle power which a player gains (Sieroń et al., 2017).

To make a player more trained, different kinds of exercises (for example, multi-joint or isolated, bilateral or unilateral), combinations of external loads (depending on a training stage and its kind) are used to improve kinetic tasks (for example, jumps, sprint running, change of direction) in a strength training (Silva et al., 2015).

Scientists have proved the important correlation between muscle power and speed (Silva-Junior et al., 2011; Hernández i Garcia, 2013; Loturco et al., 2015; Gravina et al., 2017; Hoppe et al., 2017), between muscle power and jumping ability (Gorwa et al., 2007; Chelly et al., 2010; Gajewski et al., 2018; Gozdowski et al., 2019), as well as between speed and jumping ability (Silva-Junior et al., 2011; Köklü et al., 2015). Scientific works have shown the strong correlation between generated power of a vertical jump out of a place with swing (*CMJ*) and generated running power (sprint of 30 m) (Silva-Junior et al., 2011), as well as between sprint (30 metres) and a vertical jump out of a place with swing in football (Köklü et al., 2015). It has been observed that effective activities of football players have become much more dynamic which results in a bigger number of short-term efforts made with high intensity (for example, counter-attack) and the maximum intensity (for example, sprints with a ball or without a ball). To sum up, many aspects – among others, gender, a sport level, used external load, a recreational break, a kind of exercise – influence how players' speed and jumping ability are improved.

The main goal of the work was analysis of the impact of strength training on the power of the lower limbs, the locomotive speed and jumping ability of footballers. The research material was a selected group of footballers ($n = 56$) who play in the second Polish league and who represent the similar sport level with at least 4 years of training experience in the league and in the age group 22-28 years old. The researches were conducted in the Workshop of Strength and Muscle Power at the AWF Katowice and at the Multi-purposed Hall of AWF Katowice.

The thesis has showed how to use the strategy of changeability in a strength training which is based on differentiated intensity of a training. The work is focused on comparing two strength differentiated trainings which have been differentiated in the terms of external loads: a training with an external load 50-60% 1RM and a training with an external load 70-80% 1RM. The research problem was to define the difference between the first and the second group in the terms of the power test results, jumping ability and locomotive speed after the 4-weeks macrocycle in the winter preparation period aimed at the development of muscle power.

The innovation of the work is the original combination of exercises in a strength training (*Back Squat (High Bar), Bench Press, Barbell Lunge, Pull ups, TRX Plank*) during the preparation period and the new combination of exercises which check the variables (two-legged and one-legged pressing; two-legged and one-legged squat; sprint of 5 m, 10 m, 20 m, 30 m; power, height of a vertical jump out of a place with swing (*CMJ*) to improve speed and jumping parameters.

The strong side of the researches is the use of the latest measuring devices generation which ensure the accuracy of measures and preventing injuries of lower limbs (a measurement system of photocells *Microgate Witty*, a dynamometric *ForceDecks Dual Force Plate System*, a device *Keiser Leg Press with a diagnostic module A420*, a device *Keiser Air Squat with a diagnostic module A300*). These devices are characterized by the high relevance and measuring accuracy. Also, they enable keeping the same conditions for testing every one of the researched footballers.

Measures of the biggest power generated by footballers during strength exercises (leg press and squat) were taken and their locomotive speed at 5 m, 10 m, 20 m, 30 m and jumping ability were measured during the experiments. Measures were taken before the preparation period and after it.

The results of the research analysis in the dissertation show that a training with external load 50-60% 1RM during a preparation period is a more effective method to improve power, locomotive speed and jumping ability generated by footballers much more than a training with external load 70-80% 1RM.

The researches don't study the whole range of problems connected with influence an external load has on a level of muscle power, locomotive speed and jumping ability, therefore it is worth broadening researches and taking into account a parameter of aerobic capacity or agility and their correlation with certain variables in relation to different values of an external load. In the future, it would be worth taking into account positions footballers take on a pitch, studying asymmetry of lower limbs and influence of upper limbs power on locomotive speed and jumping ability.

Using an original combination of exercise set in a strength training, using the newest generation of measurement devices and an original combination of exercises which check these variables can be tools for monitoring muscle power, speed and jumping ability and be used by trainers during a preparation process at the same time. The research goal has been achieved; the

gained results of the analyses conducted in the thesis confirm that the method of comparing strength trainings during a preparation process for footballers is correct.

The author believes the innovative approach to research on strength training, that influence on lower limbs power, locomotive speed and jumping ability of footballers is certainly important for creating an optimal model of a masterful footballer.