METHODICAL ASPECTS OF MAXIMUM SPEED DEVELOPMENT

Milan Čoh¹, Mitja Bračič¹ and Nusret Smajlović ²

¹ Faculty of Sport, University of Ljubljana, Slovenia
² Faculty of Sports and Physical Education, University of Sarajevo, BiH

Abstract

The maximum speed, which people produce in movement, depends on various factors. Maximum speed is a product of the frequency and the length of stride. Development of maximal speed is not constant, but has certain oscillations, particularly in the adolescence period. In methodology of training for development of maximal speed there are two paths available: synthetic and analytic. In synthetic training the emphasis is on the development of speed as a whole, whereas in analytic training the emphasis is on separate training of individual speed components. Finally, main strategy of efficient speed training is based on the use of such training methods and tools, which prevent stabilisation of speed. Development of maximal speed is a long term process with many scientific comprehensions included.

Key words: speed, maximum, development

Introduction

The maximum speed, which people produce in movement, depends on various factors. These factors are related to morphological and physiological characteristics, energetic mechanisms, age, gender, bio-motor abilities, inter- and intra-muscular coordination and optimal biomechanical technique of movement. Locomotive speed in a form of sprinting run is one of the most important abilities, which defines the successfulness of sportsmen in many sports situations. From the genetic (hereditary) motor programme aspect, speed can be classified into primary phylogenetic human movements. In specific sports situations, speed is being manifested in a form of a »three-segment model«. The model consists of speed, strength and coordination. Pondering of individual segments of this model depends on the particularities of specific sports discipline. Maximum speed is a product of the frequency and the length of stride. Both parameters are mutually dependant; they are also linked to the processes of central regulation of movement, to the morphological characteristics, bio-motor abilities and energetic processes. The relationship between the frequency and the length of a stride is individually defined and automated (Hay, 1993; Delecluse et. al., 1995; Donatti, 1996. Kyrolainen et. al.,2001) Changing one parameter results in the changes of a second parameter as well. When a length of a stride is increased, the frequency decreases and vice versa. With increased speed both parameters increase (see Figure 1).

Frequency of stride depends on:
- Functioning of central-neural system
- Inter- and intra-muscular coordination
- Central and peripheral neural fatigue

Figure 1: Relationship between speed, frequency and length of stride

The length of stride depends on (see Figure 2):
- Morphological characteristics (the length of lower extremities)
- The reactive force of surface (an impulse at take-off)
- Duration (time) of contact phase
- Dynamic flexibility in hips
- Take-off distance
- Touchdown distance

Figure 2: Kinematic structure of sprinting stride
Methodology of speed development

In methodology of training for development of maximal speed there are two paths available: synthetic and analytic. In synthetic training the emphasis is on the development of speed as a whole, whereas in analytic training the emphasis is on separate training of individual speed components. In both paths the basic requirements are that movement is being executed in maximal speed, with optimal rational technique where fatigue does not prevent realisation of maximal speed of movement. One of the basic training methods for development of speed is method of repetition. Basic tendency is in aiming to overcome own maximal speed (Zatsiorsky, 1975). Speed has to be maximal or sub-maximal, as only such training pushes the limit of speed in desired direction. Rest period is determined by two processes: central fatigue – excitation of neural system and physiological – biochemical parameters. Following fast movements, the excitation of neural system drastically increases and rapidly decreases after the loading. Considering this factor, the rest period could be relatively short. However, the length of rest period also depends on anaerobic functions. Rest period in speed development training needs to be sufficiently short that the level of excitation does not reduces to minimum and sufficiently long that the functional parameters return to their initial or near initial values.

Running is elementary inborn movement with already built programme in the central neural system. Efficiency of running from the speed point of view is relatively individual category, which depends on the variety of hereditary functions. In the development of children, a term “natural – biological development of sprinters speed” is being used (see Figure 3). This development depends on body height, body weight, development of biomotor abilities and the formation of motor stereotypes of movement.

Due to acceleration of longitudinal parameters, frequency and length of stride change (see Figures 4 and 5). The length of stride increases and the frequency of stride decreases significantly. Frequency does not change only as a result of morphological changes, but also due to disruption of proprio-receptive mechanisms for movement control.

![Figure 4: Development of frequency of stride in boys and girls in primary school (Bračič, Tomažin, Čoh, 2009)](image1)

![Figure 5: Development of stride length in boys and girls in primary school (Bračič, Tomažin, Čoh, 2009)](image2)

![Figure 6: Duration of contact phases of sprinters stride for boys and girls in primary school (Bračič, Tomažin, Čoh, 2009)](image3)
The biggest differences in the development of maximal speed of pupils of both genders occur between the ages of 12 and 14, mainly in boys due to development of strength. The duration of contact of sprinters stride in boys is rapidly reducing after the age of 12 (see Figure 6). Duration of contact phase is one of the main criteria in selecting young sprinters (Mero, Luhtanen and Komi, 1986; Mero, Komi and Gregor, 1992, Zatsiorsky, Kraemer 2009). Synthetic principle of speed development suggests large amount of spontaneous training of young people in different sports, where the ability is manifested also with other biomotor characteristics. Development of speed has to be related to complex motor situations with a strong informational movement component. Namely, this is a period of so-called “sensitive phase” in the development of children (9-13 years), which is very suitable for development of speed potential. Central neural system is being developed, particularly emphasised is formation of myelin nerve sheath, which serves as a transporter of neural impulses from central neural system to active muscles. In this period, particularly the speed of transfer of such impulses, which generate the speed of movement, can be influenced.

Analytical approach is related to training of individual technical elements of sprinting run, which are similar in structure to locomotion in sprint. They include ABC exercise of sprinting: skipping, jumping, running with accentuated take-off, jogging etc. These exercises might seem abstract to children, however, their role in creation of correct technical running model and prevention of technical errors is very important. Running is a natural genetic need of children. Maximal locomotive speed is an ability, which in young people has to be trained in small volume due to two reasons:

1. Young people have yet not developed mechanisms of movement control under the maximal loading. Consequences are unnatural movement, jerking movements and movement with number of errors.

2. There is a possibility for “speed barrier” occurring, which could result in stagnation in development or even in deterioration of the ability. Generally speaking, inadequate training (narrow specialisation) can lead to formation of certain stereotype in central regulation of movement, which would prevent development of speed. Speed is being based on a specific motor programme. The sooner maximal speed is being developed, more programmes become stabilised and lead to prevention of progress in this biomotor ability.

Stabilisation of speed – speed barrier

Numerous repetitions, which are necessary for creation of automated and rational movement, lead to creation of motor stereotype and consequently to stabilisation of movement. Together with stabilisation some kinematic – dynamic parameters are being set; they are manifested with the length and frequency of stride.

So-called “speed barrier” occurs, which was first explained by Soviet researcher N.G. Ozolin in 1970. The main contradiction in the development of maximal speed is following: in order to increase speed, numerous repetitions of specific move are required; on the other hand larger number of repetitions leads to strong dynamic-kinematic stereotype and strong speed barrier. In addition, the increase of training volume does not have positive effects, but even more stabilises the achieved speed of movement. Stabilisation of movement is the main inhibitor of development of speed potential.

Main strategy of efficient speed training is based on the use of such training methods and tools, which prevent stabilisation of speed. Creation of speed barrier follows certain chronology (Zatsiorski 1975):

1. phase of prevention of speed barrier
2. phase of destruction of speed barrier
3. phase of suppression of speed barrier

Tools and methods for preventing the speed barrier:

- spontaneous exercising in children
- late specialisation
- development of basic motor abilities – elementary motor movements
- overall preparation – »multi - lateral training«
- development of »motor software« - motor knowledge and skills
- development of elementary movement technique
- ABC training of running
- speed training with non-specific tools and methods (elementary and sports games, relays)

Tools for breaking of speed barrier

- non-specific running
- running down an incline
- running up an incline
- running with resistance
- running with pulling a weight
- running in low depth water
- running with and against the wind
- running in the sand
- running with a parachute
- running with »sprint machine«
- contrast sprinting runs
- multi-throwing training

Tools for surprising the speed barrier

1. Stopping the specific training
2. Substitution of speed training with the training of strength, coordination and precision
3. Technical running training
4. Coordination of running in a sub-maximal regime
5. Compensational training
Conclusion

Speed is a complex and subtle biomotor ability, which in real sports situations occurs in various forms. One of the most important segments of speed potential of sportsmen is maximal speed. From the biomechanical point of view, maximal speed is structured with the length and frequency of stride.

The goal of training process is improvement of these two segments, which are relatively highly genetically pondered and depend on several neuromuscular factors. Development of maximal speed is a long term process, which is related to optimal control of agonist and antagonist muscles of sprinting movement pattern.

Literature


METODIČKI ASPEKTI RAZVOJA MAKSIMALNE BRZINE

Maksimalna brzina, koju ljudi produciranju u kretanju, ovisi o više faktora. Maksimalna brzina je produkt frekvencije i duljine koraka. Razvoj maksimalne brzine nije konstanta, već pokazuje određene oscijalacije, posebno u razdoblju adolescencije. U metodologiji treninga za razvoj maksimalne brzine postoje dva moguća pristupa: sintetički i analitički. U sintetičkom treningu naglasak je na razvoju brzine u cjelini, dok je u analitičkom treningu naglasak na odvojene treninge pojedinačnih komponenti brzine. Konačno, glavna strategija efikasnog treninga brzine temelji se na korištenju trenažnih modela kao alata, čime se prevenira stabilizacija brzine. Razvoj maksimalne brzine je dugoročni process s mnogo uključenih znanstvenih spoznaja.

Ključne riječi: brzina, maksimum, razvoj

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Correspondence to:
Prof. Milan Čoh, PhD
University of Ljubljana
Faculty of Sport
1000 Ljubljana, Gortanova 22, Slovenia
Phone: 00 386 (0)1 520 7823
E-mail: milan.coh@fsp.uni-lj.si