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FROM BIOMECHANICAL ANALYSIS TO THE DEVELOPMENT OF THE EXPLOSIVE MUSCULAR FORCE SPECIFIC OF THE SPRINTER

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Abstract: *At present, the importance of developing explosive muscular force in training the high performance sprinter is beyond discussion. Practical experience has been consolidated from this standpoint for more than a few decades. In exchange, the contents have considerably evolved for the last years. Initially inspired, for the greatest part, from the bar bell techniques, there have gradually appeared contents better adapted to the characteristics of the activity and, consequently, more specific.*

Key words*: explosive muscular force, propulsive force, flying phase, support phase, muscular chains.*

1. Introduction

The objective of this presentation is to contribute to defining an assembly of exercises aiming at developing specific muscular force starting from a biomechanical analysis.

Our attention will be directed, in the present case, towards the phase of running at full speed.

In general, the runner's muscular activity will be organized around three main functional elements.

Propulsion: the runner acts upon the ground through the intermediary of a unilateral support (on a leg)

During the interaction ground-sole, the propulsive forces are applied to the runner, and the muscular strain is maximal. The development of the muscular force may be deemed as a propitious means for obtaining the best efficiency of the motion. The present paper will mainly focus on the analysis of this functional element.

Equilibration (development of the muscular support pelvis –trunk)

The rigidity of the connection pelvis-trunk is determined as regards the effectiveness of the support. As a matter of fact, the runner has to be considered as a deformable mechanical system. At the moment of the support, the reaction forces of the soil may cause the relative drive of certain elements of this assembly, some in relation to others. (basin-trunk).This effect is undesirable to the extent that it may totally or partially annul the dynamic effect of the soil reaction, leading this way to an objective aimed at. Driving the abdominal dorsal-lumbar muscles may considerably reduce the deformation of the pelvis-trunk connection during the support phase, this way contributing to a better effectiveness of the support. Consequently, the exercises

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of developing muscular force, of the so-called "muscular support for the assembly pelvis-trunk", will constitute a constant element of the specific work in sprint.

The dynamic equilibrium of the body in motion and continuity (enlacement) of the action

During the support phase, the central axis of the body carries out a rotation movement around the support leg. This rotation movement has to be at the same time extremely quick forwards and stopped at the end of the support for the maintenance of the general equilibrium of the body during the flight (aerial) stage which will follow.

The free segments (in the first place, the free, osculating leg and in the second place the arms) ensure a great part of this double function. In the framework of the development of muscular force there has to be taken into consideration the muscular strain which ensured the sequence of return forwards and of impending the free leg.

The amplitude, the frequency of the running step and the "cycle of the step" stand for the technical indicators most frequently used in order to assess the effectiveness of this step. The present study aims at specifying the modifications of the cinematic parameters of the running step in connection with the optimization of the frequency and/or of the amplitude during the running phase "at full speed" for the sprinters, and hence deduce the new requirements that should be met by the muscular chains which ensure the phase of support of the running. Eventually, we will infer from this analysis a series of organizational principles for the development of the speed runner's specific muscular force.

2. Explosive Force Training in Sprinters

During the last 20 years, especially after the PG years, the training of explosive force in the sprinters has constituted one of the most important factors in achieving performance. In settling an optimal program, there have to be taken into consideration certain factors: the athlete's chronological age, his/her general physical development, the years of practicing athletics, the level of training, the period of training.

It was noted that, over the last years, many trainers have used the same ideas and theories. After 1977, a new system was used in which exercises with dumb bells were made, followed by multiple jumps which ended with short sprints. This system was used by the Italian trainer Carlo Viitori, and it is deemed to be erroneous. However, practice has proved the contrary, the results not lingering, especially after it was adopted in the USA.

The reason for this style of work is simple: so that the sportsman should manifest an explosion, he/she has to work at maximal frequency during a long period of time, also avoiding accidents. The explanation for this system is the following: when the training with dumb bells is executed, the contractions are concentric, therefore the muscle is rarely extended or elongated. For this purpose it was resorted to an experimental study upon the sprinters' behaviour through the method of repeating some series **of quick grazing step,** on different distances.

The research was developed from January 15th to April 15th 2007 at L.P.S. Brasov.

All the eight subjects at the beginning of the research were tested in the five events, plus the one we proposed (50 m running with quick grazing step):

- 30 m running downward start
- 30 m running launched start
- 100 m running downward start
- long jump without running start
- triple jump without running start
- 50 m running with quick grazing step (proposed event)

INITIAL TESTING

NAMESUB.	30 m a.S.j	30 m a. S. 1	100 m a.S.j	Long jump no running	triple no running	50 m running steps Nr steps	time
G.S.	4,32 sec	3,1 sec	11,8 sec	2,35 m	8,29 m	22 steps	8,9
S.Z.	4,35 sec	3,3 sec	12,0 sec	2,3 m	8,25 m	23 steps	9,01
B.A.	4,32 sec	3,24 sec	11,85 sec	2,35 m	8,27 m	22 steps	8,91
T.P.	4,2 sec	3,1 sec	11,5 sec	2,4 m	8,35 m	20 steps	8,89
H.I.	4,4 sec	3,3 sec	12,4 sec	2,34 m	7,93 m	23 steps	9,11
P.A.	4,3 sec	3,21 sec	11,75 sec	2,38 m	8,3 m	21 steps	8,9
C.R.	4,26 sec	3,1 sec	11,7 sec	2,4 m	8,3 m	21 steps	8,91
GHE.S.	4,2 sec	3,12 sec	11,5 sec	2,45 m	8,35 m	22 steps	8,9

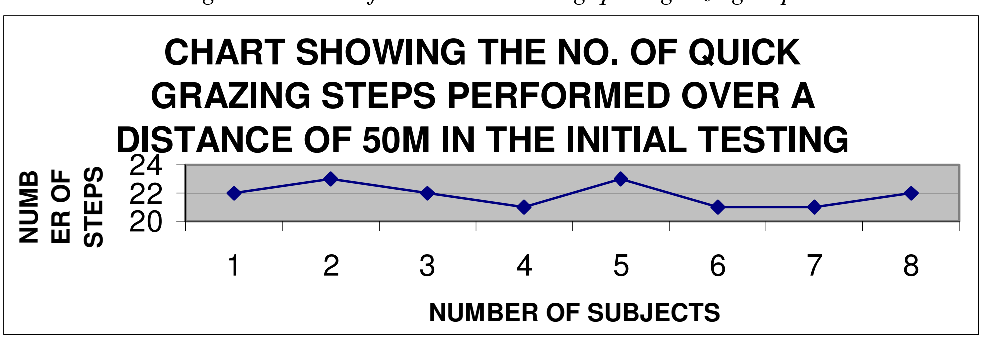
FINAL TESTING

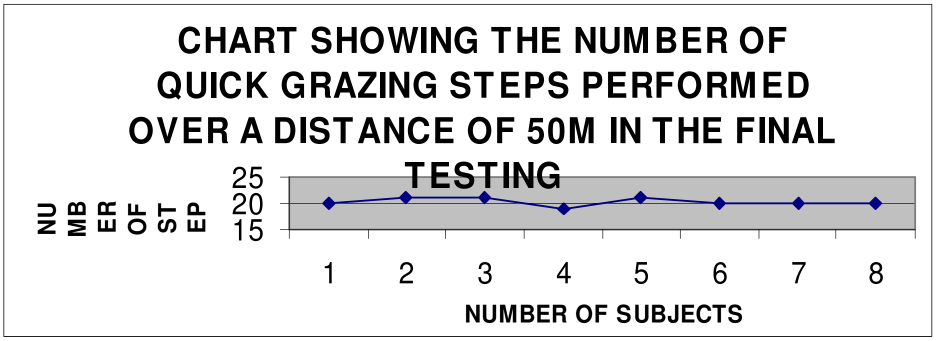
NAME SUB.	30 m a.S.j	30 m a. S. 1	100 m a.S.j	Long jump no running	triple No running	50 m running steps Nr steps	no running
G.S.	4,27	3,08	11,61	2,46	8,39	20	8,5
S.Z.	4,2	3,25	11,92	2,35	8,36	21	8,8
B.A.	4,28	3,21	11,63	2,41	8,39	21	8,7
T.P.	4,1	3,05	11,31	2,61	8,45	19	8,4
H.I.	4,27	3,27	12,05	2,39	8,2	21	8,8
P.A.	4,25	3,18	11,5	2,49	8,39	20	8,4
C.R.	4,2	3,07	11,45	2,5	8,4	20	8,7
GHE.S.	4,1	3,05	11,3	2,64	8,45	20	8,5

As we noted from the final testing, the program submitted for the rationalization and standardization of the working values achieved the tasks proposed by:

- the working volume during the 4 months used for the development of the force, of the resistance, of the motric qualities prevailing in the event.
- working intensity upon effort stages as well as the speed for going through the different distances of training; the distances and the number of repetitions during the training used for the development of one of the motric qualities mentioned.

Graphical representation of the results obtained during the initial testing and the final testing in the event of 50 meters running quick grazing step





Comparative table of the results obtained following the application of the operative model and the results presented in the Fischer Table, for a number of eight subjects.

EVENTS	"t"according to" Fischer" table		"t"obtained in research	
30 m.S.l.		**3,49**		**5,31**
100 m.S.j.		3,499		4,25
Lg jump no running start		3,49		3,66
Triple with no running start		3,499		4
50 m running quick step No steps		3,499		4,14
50 m running quick step time		2,365		2,83

Calculating the significance of the differences between the averages of the correlated samplings, in the initial testing and in the final testing, "t" calculated seemed to be higher than the "t" present in the "Fischer Table of values", which confirms the working hypothesis and rejects the void hypothesis, with a percentage of probability of 99,99%.

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