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Research Article

A Different Reality of the Sprint. The Source of Power that Propels the Athlete While Running at Maximum Speed

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Abstract

The analysis of human evolution led us to bewilderment, why the ancient man, as if specially received from evolution, is not the most rational mechanism for generating kinetic energy for running. Our research led us to the conclusion that myofibrils (actin and myosin) are absolutely unsuitable as a kinetic force generator for running at maximum speed [1,3-5]. Using the example of a high jump, we showed that the reason for this is the high density of the medium (cytoplasm) in which actomyosin works, as well as the spherical structure of the actin and myosin chains. As a result, an increase in the speed of movement of the actin and myosin chains in the cytoplasm, during the contractile act, causes an increase in the resistance of the medium by the value squared. This is the reason that the muscular-contractile mechanics is not able to provide a high speed of muscle contraction, for running at maximum speed. It follows from this that the ancient man - homo-erectus, which appeared on the earth 2 million years ago, being significantly inferior to predators in escape speed, should have simply been a link in someone's food chain. But we are, and it means that he, homo-erectus, was able to survive and successfully transform into homo-sapiens. But how did our distant predecessors manage not to become the prey of predators. Perhaps, in their locomotions, they used not muscular-contractile, but some other mechanics of generating kinetic energy for running, which allowed him to reach a radically higher speed when running away? We conducted a study and identified this other mechanism that moves a person at the fastest pace possible. It differs radically from the existing understanding of the mechanics of fast running and has nothing to do with the power of contraction of the leg muscles, but comes from a different dimension. The correctness of our conclusions has been proven in a long-term pedagogical experiment. The aim of the study is to find out what is the source of kinetic energy that propels the athlete when running at maximum speed. Research methods and organization. For the study, the analysis of scientific and methodological literature, testing, methods of mathematical statistics were applied.

***Keywords:** Driving Force Generator; Vertical Interactions; Shoulder Girdle Work; Centrifugal Forces; Tendon Deformation; Pogo Stick*

Introduction

What force moves the athlete during horizontal locomotion - running at maximum speed? It would seem that the answer is obvious and simple to the point of banality - the athlete is driven by the powerful work of the leg muscles, provided by the energy of creatine phosphate [5]. It is also obvious that in sports where running with maximum speed is present (sprint, takeoff in the long jump), African Americans dominate, but the indication of the factor of their superiority is veiled by the word “genetics”. Our knowledge of physiology suggests that this is possible: more porous bones of the musculoskeletal system (like in birds); other myofibrils, consisting of a special combination of amino acids; more energy-intensive creatine phosphate; higher frequency and strength of central nervous impulses; special mediators and synapses; faster evacuation of calcium, etc. At the moment, science and practice have not provided answers to these questions. But in order to understand this issue, first, let us point out the contradictions between words and deeds in the activities of coaches. Examining the training and competitive activity of athletes-sprinters, one can notice how coaches, while running, sometimes give them emotional commands such as: "work more energetically (more often) with your hands!" But it is believed that running is carried out due to the powerful work of the leg muscles. And from these positions, their wards spend the lion's share of the training time precisely on working with a barbell, on performing various jumps and working on simulators. By doing this, they prepare themselves precisely to push harder. Why, then, are the verbal commands of the trainers used "work with your hands more often"? It is here that there is a mismatch between word and deed: is the upbringing of motor qualities aimed at strong repulsion, and is the verbal message directed at the hands? Perhaps it is easier to set the pace of movements through your hands? However, let's say in advance, not everything is as obvious as it might seem at first glance. Until now, the question of the contribution of the hands to the mechanics of running has been limited to mentioning their cross-coordination. We have not found more detailed studies on the role of hands in running. In practice, the coaches tirelessly instilled in their wards the importance of relaxing the shoulder girdle while running, so that the irradiation of tension coming from the hands would not restrain the athlete as a whole. Is this belief in the rudimentary nature of the hands as an organ that does not play a significant role in sprint running? We conducted a study, the conclusions of which, as if from another dimension, reveal to us an unexpected picture of the mechanics of running at maximum speed. And before giving a justification for other mechanics, let us revise the existing paradigm of the mechanics of running with maximum speed. The paradigm used is entirely based on the contractile work of the leg muscles. Here is a typical description of a running stride while running at maximum speed: "During running," when pushing off, the shoulders are slightly retracted... In the amortization phase, flexion occurs in the hip and knee joints and extension in the ankle... The angle of flexion in the knee joint reaches 140 - 148°, at the moment of the greatest shock absorption. In the take-off phase, the runner energetically brings his leg forward upward... The push-off ends with the extension of the supporting leg..." [9]. As you can see, "repulsion" and "amortization" are presented to us as the dominant and most important elements of the mechanics of the implementation of this locomotion. But let's dissect this description.

Repulsion, like the rapid contractile work of muscles, cannot be manifested during running at maximum speed. We have already given a justification for such a statement, using the example of a high jump in our previous publication [1,3,4]. It comes from the fact that the support time is so short (0.12 - 0.17s) that the understanding of the performance of fast contractile work by muscles (actomyosin) is an aberration. No muscle strength gradient can cope with the task of achieving high dynamic characteristics during this instant (0.1s) time interval during the interaction of the leg with the treadmill. As we already indicated in the previous publication, this is hindered by the structural features of the sarcomere, which is a structural and functional unit of striated muscle tissue [1,3,4]:

- High density of the cytoplasm, which contains contractile elements - actin and myosin;
- The spherical structure of actin and myosin molecules, in connection with which, when they move in the sarcoplasmic reticulum, an inhibitory turbulent resistance occurs;
- The law of physics, which is expressed in the fact that when a body moves in a liquid, the resistance (F) increases in proportion to the square of the velocity (V) [7]: $Fs. = k_2 V^2$ (1).

As it may seem, nature, or the creator, as if specially created such conditions for the muscles so that a person could not run fast and was simply a link in someone's food chain. But this is not the case. Homo-erectus, which appeared on the earth 2 million years ago, survived as a species, which means that when running (running away) it used some other mechanism. Yes, indeed, evolution and the creator endowed man with a much more perfect mover. Using the example of a high jump from a run [1,3-5], we have shown that locomotions with a short interval of interaction with the supporting surface, with extreme dynamic interactions, are carried out not due to muscle contractions, but due to deformation and return work of tendons ... Muscular contractions are not able to provide high dynamic characteristics of the high jump, recorded by the measuring equipment. For example, in a high jump, instantaneous pressure on the tensoplatform, with a force of 372 kg, achieved in 0.02s, is a phenomenon that contradicts the physiology of muscle contraction and the basic equation of muscle dynamics (A. Hill). And the magnitude of the muscle effort of the jogging leg and the gradient of the increase in effort are more than 15 times higher than the physiological capabilities of a person [4]. In addition, we have precisely established that when taking a run along an arc and when performing a swing with the leg and arms, centrifugal forces of more than 350 kg arise [5]. The question is, how, under such conditions, the muscles of the jogging leg can give the body a vertical takeoff speed of 4 and even 5 m/s. This cannot be done by muscular contractions. And it is no coincidence that in our studies testing the explosive ability of muscles and maximum strength did not reveal a correlation with the competitive result [4]. Our studies of the high jump showed that the mechanism and generator of kinetic energy is the force of tendon deformation. In sprint running, the contact time with the ground is even shorter. Therefore, we have reason to assert that the above description of sprint running [9], using the term "repulsion" is an aberration.

I would especially like to dwell on the term "amortization" used in this text: "In the amortization phase, flexion occurs in the hip and knee joints and extension in the ankle... The angle of flexion in the knee joint reaches 140-148^o, at the moment of the greatest shock absorption". The word "amortization" (from the French amortir) means weakening, absorption, softening of shocks. That is, softening the blows is how this word is interpreted. But Professor P. Weyand, one of the world's leading specialists in biomechanics, has the opposite opinion on this matter. He argues that when "athletes are running at a constant speed... the main factor affecting speed is how hard the sprinter hits the ground with their feet" [10]. Not depreciation, not mitigation, but on the contrary, shock effect. We tend to believe that running with maximum speed, as in the high jump, due to the even shorter period of interaction between the athlete and the treadmill, is also carried out not at the expense of the energy of muscular contraction, but at the expense of the deformation energy of the tendons. But the question arises, how is the implementation of this model of running at maximum speed carried out? What force deforms (stretches) the tendons and where does it come from? So there must be some kind of outside force. But where does it come from? Thus, based on the analytics, we have identified three aspects:

1. Muscle contractions cannot be a generator of kinetic energy when an athlete runs at maximum speed;
2. For this, the energy of elastic deformation can be used;
3. The source of energy and the mechanism of tendon deformation is unknown.

Research Objectives and Methods

In connection with the question posed, a study was carried out, the purpose of which was:

- To revise the understanding of the driving mechanisms in sprint running;
- To identify alternative driving force mechanics in sprint running.

Research Results and Discussion

To come to an understanding of our alternative dynamics of running at maximum speed, we studied photographs of grimaces (French: Grimace - unintentional distortion of facial features) of Usain Bolt during a competitive run at the Olympics (London, 2012) and compared with a pilot's grimace while performing aerobatics (Figure 1). In this case, we used the grimace as an indicator indicating the presence of external influences. Looking at the pictures showing W. Bolt, many sprint specialists will point out the relaxation of facial muscles, thereby summarizing the rationale for the need for maximum relaxation of not only the muscles of the face, but also the whole body while running.

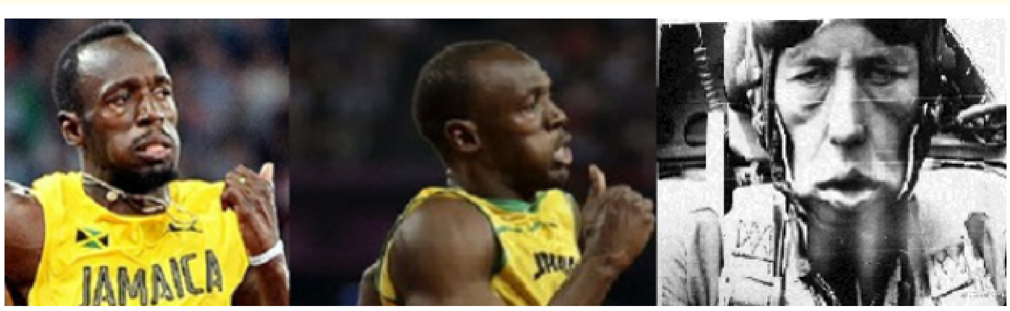

Figure 1: *Grimace of Usain Bolt's face while running and a grimace of the pilot's face while performing aerobatics.*

Let us compare these pictures with a photograph of a pilot. They show a surprising similarity. Does this mean that Usain Bolt, while running, also experiences overloads comparable to the overloads of a pilot? But where do they come from in horizontal sprint movement? We assumed that the source of these overloads is the centrifugal force generated by the movements of the limbs. To test this concept, we examined the video recording of Usain Bolt's running in order to identify the source and magnitude of the centrifugal forces created by the limbs during the run. When running, the arms move along an arcuate trajectory, this indicates that centrifugal forces inevitably arise, directed downward and acting on the athlete's musculoskeletal system. But the movement of the center of mass of the leg, as it turned out, actually passes along a tangent. This means that when the leg is brought forward, centrifugal force does not arise, or its value is insignificant (Figure 2).

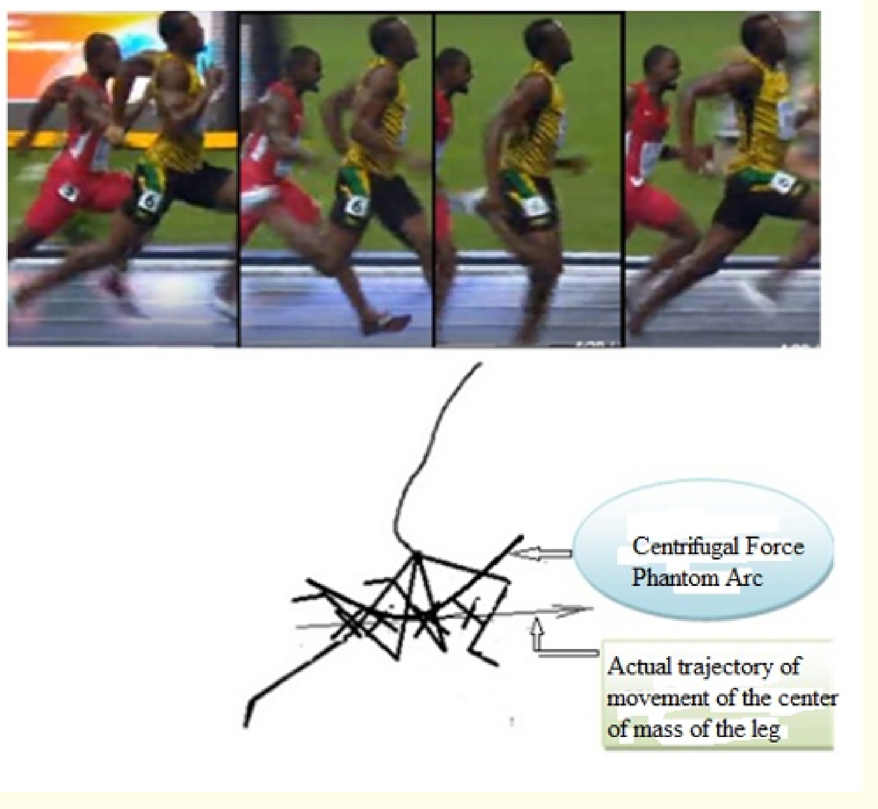

Figure 2: *Cinematic and cyclogram of the trajectory of the center of mass of the leg (indicated by crosses) of Usain Bolt.*

To determine the magnitude of centrifugal forces created by hand movements, we used segmentation of body parts [1], curvimetry, and scaling. The algorithm for applying these techniques is described in detail using the example of the study of the high jump in our previous publication [5]. Applying these techniques, we obtained the following initial data (Table 1).

N p/p	Name of indicator	Value	Method of obtaining results
1.	Weight of one hand (kg) (4.9% of body weight U. Bolt 94 kg)	4,6	Segmentation of body parts
2.	The path traversed by the center of mass of the hand (m)	20,64	Curvimetry
	Movement time (s)	0,1	Corresponds to t support
	The speed of movement of the center of mass of the hand (m/s)	6,4	V = S (m.): T (s)
3.	The radius of movement of the center of mass of the hand (m)	0,25	Segmentation of body parts

Table 1: *The initial anatomical and biomechanical parameters arising from the work of the hands during the run of Usain Bolt at maximum speed.*

Substituting the obtained data into the formula:

$F = mv^2/r$,

We found that the centrifugal force (F) depends on the mass of the body part (m), the speed of movement of the body part (v), the radius of the trajectory of the body part (r) and determined that the magnitude of the action of centrifugal force, when moving with one hand, is 76.9 kg. Therefore, the total value of the centrifugal force when working with two hands is 153.8 kg. This load, at the moment of support, is directed downward and transfers its effect, through the cytoplasm support, to the tendons of the foot, lower leg and thigh, sets the deformation and their subsequent work [3]. That is, the centrifugal force caused by the work of the hands is directed downward and acts as a factor in the deformation of the tendons. In response to this force, the tendons generate kinetic energy for running. The generation of energy precisely due to tendons, and not muscles, is evidenced by the experience demonstrated, at one time, by the trainer-researcher V. Voinov. A test subject was invited to conduct the experiment. We asked her to make a jump up from the spot. It is quite natural that she jumped up before overseeding. We asked her a question: "Why did you get hooked before jumping out?" Her answer was quite professional and logical - "On straightened legs, there is nothing to push out with. Therefore, before the jump, I first sat down, then, with the help of muscle contraction and extension of the legs in the joints, jump up. Everything is correct and logical! We tried again, but before the jump, they suggested that she first sit down and take the "working" starting position, fix it, and only then, perform a vertical jump. But, a strange thing, having taken the initial position of "half-squat" - frame 1., the subject made an even deeper crouching - frame 2 and only then jumped up - frame 3 (Figure 3).

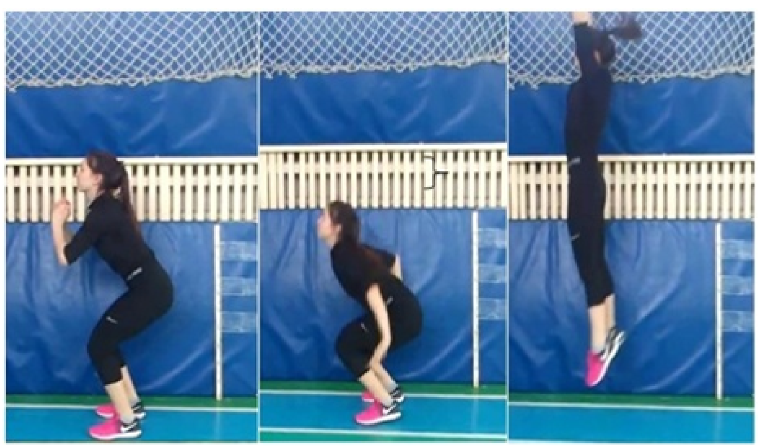

Figure 3: *Experience of V. Voinov jumping up from the starting position "sit down".*

The question arises: why did she do an even deeper squat from the already accepted starting position of the "half-squat"? After all, she has already taken the starting position that is necessary for muscle contraction and joint work! We made simple mathematical calculations (t - execution time 0.16s, distance traveled - 0.22 m.) And using the formula [8]: $K = mV^2 / 2$ (2).

Determined that the athlete, by braking and changing the direction of movement, made it difficult for herself to work conditions for the muscles by more than 5 kg, that is, by almost 10% (Table 2).

N p/p	Name of the mathematical action	Initial data	Formula	Obtained value
1.	Calculation of speed when moving down	t - 0.16 s s - 0.22 m.	V = s/t	1.375 m/s
2.	Calculation of the magnitude of the kinetic energy accumulated before the moment of changing the direction of movement	m = 52 kg V = 1.375 m/s	$K = mV^2/2$	5.01 kg

Table 2: *The value of the athlete's burden at the moment of changing the direction of movement at the moment of additional sitting.*

For what purpose did she create an additional burden for herself in the form of a reciprocating movement up and down? But here we must also add the action of centrifugal force, also directed vertically downward, arising when the arms move in an arc when performing a swing [11] (Table 3).

N p/p	Indicator	Source (method) of finding a given	Value
1.	Weight of two arms 4.9 x 2 = 9.8% of body weight (m)	Segmentation of body weight	5.3 kg
2.	Action time (t)	Calibration of the time interval	0.16s
3.	Path length when performing swing movements (L)	Curvimetry	0.4m
4.	Speed (V)	V = s / t	2.5 m/s
5.	Radius (r)	Segmentation of body masses	0.25m
The total value of the action of centrifugal forces		$K = mV^2/r$	13.25 kg (25.48% of the athlete's own weight)

Table 3: *The amount of burdening a sportswoman (N.A.) with centrifugal forces when performing a swing with her hands.*

The amount of burden created by the centrifugal force caused by the swing of the arms was 13.25 kg, or 25.48% of the athlete's own weight. And the total action of the forces directed in the opposite direction from the vertical movement of the jumper reached the value (5.01 kg + 13.25 kg) 18.26 kg, or 35.1% of its own weight! The question arises: why did the athlete burden her leg muscles by 35.1% with this additional squat, with a change in the direction of movement and swinging her arms? At the same time, researchers Lees A., Van Renterghem J., De Clercq D indicate that a semicircular movement of the hands helps the jumper to fly 28% higher [7]. There is a clear contradiction here: additional squatting with a progressive-return change in the direction of movement of the athlete causes an additional burden of 10%; swinging the arms burdens the jumper by another 25.48%; however, this movement can allow you to jump 28% higher. That is, the total value of the encumbrance exceeds 35% of its own weight.

But the jumper does not refuse these encumbrances, but rather uses them in a vertical jump from the spot. This assumes a 28% increase in jump height. This contradiction can only be explained by the fact that, yes, the muscles are burdened with additional stress. But it is not the muscles that are the movers in this motor act. Taking into account that tendons can be an alternative mover, then everything falls into place. This additional load, from an encumbrance, turns into a necessary deforming action. The arm swing is the factor that creates an instant downward load and deforms the tendons. Moreover, the greater this external influence, the greater the response of the tendons. Similarly, for Usain Bolt, the value of centrifugal force (153.8 kg) created by the work of the hands is not an encumbrance, but a useful deforming factor that gives energy to movement. This final statement about the beneficial value of the deforming effect is proved by our testing of young athletes (sprint running, high jumps) in the group of sports perfection. The essence of the testing was to analyze what the results would be when jumping up from a place with different values of the encumbrance of the swing with the arms: when jumping up without swinging hands; when jumping up with a swing of hands; when jumping up with a swing of hands with dumbbells (0.5 kg) in hands? The test results are presented in table 4.

N n/n	F. Name of the subject	Result in jumping upwards from the spot (sm)			
		Without arm swing	With arm swing	With arm swing with dumbbells weighing 0.5 kg	Difference (jump without swing and jump with dumb-bells)
1.	N. Anastasia	45	53	63	17 (36,9%)
2.	V. Nikita	51	63	67	16 (31%)
3.	F. Victoria	43	44	50	7 (16.2%)
4.	V. Sofya	49	53	60	11 (21%)
5.	P. Dmitry	63	67	75	12 (20.2%)
6.	K. Yana	47	55	57	10 (21.1%)
Average		48	56	62	12.3 (25.1%)

Table 4: *Test results in jumping up from a place under various conditions of hand swing.*

In all cases, the jump with a swing with additional weights with dumbbells was 16.2 - 36.9% more effective than the jump without swinging the arms. We calculated on an individual athlete (N.A.) the magnitude of the action of centrifugal force when performing a swing with hands with dumbbells (Table 5).

N p/p	Indicator	Source (method) of finding a given value	Value
1.	Weight of two arms 4.9 kg x 2 = 9.8% of body weight + weight of two dumbbells 0.5 kg each (m)	Segmentation of body weights	6.3 kg
2.	Action time (t)	Calibration of the time interval	0.16s
3.	Path length when performing swing movements (L)	Curvimetry	0.4m
4.	Speed (V)	V = s / t	2.5 m/s
5.	Radius (r)	Segmentation of body masses	0.25 m.
6.	The total value of the action of centrifugal forces	$K = mV^2 / r$	16.07 kg (30.9% of the athlete's own weight)

Table 5: *The magnitude of the action of centrifugal force when performing a swing with hands with dumbbells in subject.*

And compared with the magnitude of the action of centrifugal forces when swinging hands without dumbbells (Table 3) - 13.25 kg (25.48% of the athlete's own weight) As you can see: when swinging hands without dumbbells, the burden is 25.48% of its own weight; when using dumbbells, muscle burden increases to 30.9%; but the take-off height increases by 36.9%. The question is, where does the increase come from? It's very simple - this increase was given by centrifugal force, which increased when swinging with dumbbells. It should be assumed that this force more deformed the tendons (rectus femoris, own ligament of the kneecap, ligament of the medial muscle, Achilles tendon), in response to which we received a greater response in the form of a higher jump. More centrifugal force action, more deformation - higher overhang. And this pattern cannot be explained by muscular-contractile mechanics. Not muscular-contractile work, but the counter-action of forces caused by the action of centrifugal forces, causing the deformation of the tendons, is the basis of the movement. Not shock absorption, in order to soften, but an active, shock effect, in order to obtain greater deformation. This is in tune with the conclusions of the professor of biomechanics P. Weyand about the impact of the legs during running and the use of a limb as a pogo stick (Figure 4) [10].

Figure 4: *Visualization of the confluence of images of movement on the pogo stick with the phases of running.*

In this way: Intense hand work while running, creating a centrifugal force of 158 kg (U. Bolt), directed downward and deforming the tendons of the musculoskeletal system; Impact of the legs on the supporting surface (association with movement to the churchyard according to P. Weyand), causing deformation of the tendons; Artificial additional squatting, when jumping up from the spot (the experience of V. Voinov), all this is one and the same image, but in different guises. And they mean one thing: not a muscular-contractile movement, but the energy of deformation of the tendons that move the athlete along the treadmill while running at maximum speed. This conclusion casts doubt on the adopted system of training sprinter athletes and jumpers using the muscle-contractile paradigm. In accordance with the dialectic of cognition of truth - from living contemplation to abstract thinking and from it to practice, we present the results of our long-term pedagogical experiment. Its essence was that in order for our wards to run faster, we did not follow the path of training fast and powerful repulsion. We trained the strength of the shoulder girdle. Figure 5 shows some examples of the exercises we use in training maximum running speed (Figure 5).

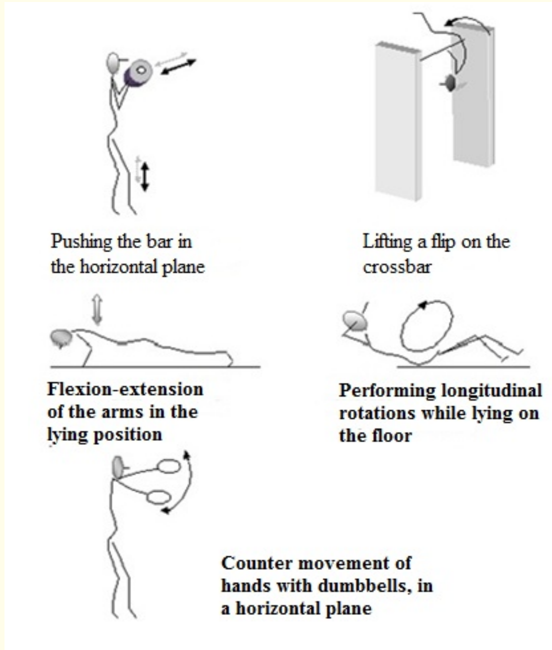

Figure 5: *Exercises for the power of the athlete's shoulder girdle.*

As you can see, there are no exercises aimed at training the powerful work of the leg muscles. Everything is aimed at training the shoulder girdle, which should create the greatest centrifugal force, therefore, an increased deformation of the tendons and their corresponding response. More powerful work of the shoulder girdle gives a corresponding increase in running speed. That is, in order to get a higher running speed, we trained the shoulder girdle. The level of training of the shoulder girdle of our athletes is eloquently evidenced by the test results (Table 6).

No.	F. N.	Pulling up on the bar (number of times)	Lifting force on the bar (number of times)	Bench press (kg)	Long jump from a place (m.)
1.	M.O.	More than 40		70	2,80
2	D.N.		10	70	2,70
3.	V.U.	30		60	2,60
4.	M.G.	28		60	2,65
5.	Zh.V.	30		60	2,65
6.	N.N.		3	50	
7.	Z.N.	More than 30	8		2,70

Table 6: *Indicators of the strength of the shoulder girdle and the explosive ability of the muscles (in the long jump from the spot) among girls sprinters (200m).*

As you can see, the girls who trained according to this program could easily pull up on the crossbar from 30 times or more or perform a lift with force on the crossbar - up to 10 times (!), Or make a lift overturn more than 30 times, or perform a barbell press weighing 65 - 70 kg. These indicators eloquently testify to the high athletic training of our wards. At the same time, we refused to educate the explosive ability of the leg muscles. As a result, the indicator of the explosive ability of the muscles, which we judged from the long jump from a place, was only 2.60 - 2.75 meters, which is not a high criterion for highly qualified women sprinters. But we did not consider this a major oversight, as the focus was on increasing the power of the hand. And, implementing these directions, we got good results in the 200-meter sprint and in running jumps. So for the period 1993-2017 using:

- Means aimed at training the strength of the shoulder girdle - 50 - 80% of the training time;
- Power tools for leg muscles (jumping on the sand, or on a soft ground) - 5 - 10% of the training time;
- Means of impact (jumping-jumping on a curbstone 70 cm, jumping over barriers) - 5 - 8% of the training time;
- Means of sprint training (hurdles, short runs, downhill runs) - 5 - 15% of the training time, our students won 5 medals:
    - World Championship (military personnel) - 2003 - Catania (Italy);
    - European Championships (1997 - Turku - Finland, 2005 - Kaunas - Lithuania);
    - European Cup - 2001 - Bremen (Germany);
    - More than 20 medals at various European tournaments;
    - More than 50 medals at the national championships and championships (Table 7).

N	F. N./gender	Years of performance	Level of performances	Competitive form/personal record
1.	M.O./w	1993-2004	European Cup -1v., 2v., European Championship - 2v., World Championship (military personnel) - 2v.	200m. - 23.35s. 400m. (indoors) -52.62s
2.	S.O./w	1993-1998	European Youth Olympic Days (1995 - England) - participation	100m. s/b - 14.7 s.
3.	Z.N./w.	1993-1997	Championship of the country (up to 20 years old) - 3v.	100m. -11.82s.
4.	M.A./m.	1994-1998	European Championship (under 20 years old) - participation (4v.), National Championship - 1v	100m. -10.2s
5.	F.O./w.	1993-1997	Championship of the country (up to 18 years old) - 3v.	100m. - 11.7s.
6.	V.U./w.	1996-2005	Championship of the country (up to 20 years old) - 2v.	200m.-23.9s.
7.	M.G./w.	1996-2005	Championship of the country (up to 20 years old) - 2v.	100m-11.6s.
8.	M.K./m.	1992-2003	National Championship - final	100m, - 10.3s
9.	S.A./m.	2002-2005	National Championship - final	100m. - 10.4s
10.	D.N./w.	2002-2010	European Championship (U20) - 2v.	200m. - 23.39s.
11.	A.T./m.	2003-2011	National Championship (U23) - final	400m. - 47.76s.
12.	S.L./w.	1993-2003	Championship of the country (up to 16 years old) - 3v.	100m. - 12.05s.
13.	I.I./f.	200m. - 24.5s	200m. - 24.5s Championship of the country (up to 16 years old) - 2v.	200m. - 24.5s
14.	D.R./m.	2006-2012	Championship of the country (up to 23 years old) - 3v.	400m. -47.30s.
15.	Zh.V./f.	2012-2018	Championship of the country (up to 23 years old) - 1v.	Long jump - 6.37 m.

Table 7: *Skill level of athletes trained on the basis of the concept of training the shoulder girdle as a generator of driving force.*

There are certainly no athletes on this list like Usain Bolt, Florence Griffith-Joyner, or Elaine Thompson. However, this long-term experiment showed that we rejected the muscle-contractile paradigm, having not the most gifted athletes, using the concept of shoulder girdle training, we achieved significant results. Perhaps someone will doubt the validity of the conclusions and the results of the experiment. However, look at figure 6, which shows pictures of the stars of the world sprint.

Figure 6: *The muscles of the shoulder girdle in Olympic and World Champions Michael Johnson, Justin Gatlin, Asafa Powell.*

Isn't the visual assessment of the shoulder girdle power of these world sprint stars the answer to the secret of their superiority? Our research provides the basis for the claim that running at maximum speed uses the momentum generated by the powerful work of the arms. Hands, which until now have been perceived as rudimet, in reality turned out to be the most important factor in fast running. Based on the statement of P. Weyand that in sprint running 90% of the energy is accounted for by vertical interactions [10], it can be argued that running at maximum speed is 90% provided by the work of the hands. After all, it is the work of the hands that sets the magnitude of the vertical interactions. The hand factor, perceived by many coaches as a sprint rudiment, has proven to be the leading factor in sprint running at maximum speed. And here the words from the Scripture are the best fit: "The stone that the builders rejected, the same became the head of the corner" (Matthew 21:42) [6].

Conclusion

Based on video analysis and mathematical calculations, we came to the conclusion that:

1. Fast running of a person is carried out not at the expense of powerful leg work. The short duration of the support period (0.1s) when running at maximum speed cannot be realized due to the contractile work of the muscles. We argue that running at maximum speed is carried out due to the deformation of the tendons (Achilles tendon, own ligament of the kneecap, tendon of the rectus femoris and medial ligament and ligaments of the plantar muscles of the foot) and their subsequent return work.

2. The generator of the driving force is the work of the hands, as a result of which a centrifugal force arises, which, for example, in W. Bolt's, reaches 153.8 kg, is directed downward and acts as a factor of tendon deformation.

3. This statement is consonant with P. Weyand's conclusions about the impact of the legs on the track, which is also a deforming factor for stretching the tendons and their subsequent return action.

4. Based on the statement of P. Weyand [10], we assert that running at maximum speed is 90% provided by the work of the hands. The arms are by no means a rudiment of sprint running, but the main factor that propels the athlete forward while running at maximum speed.
5. These conclusions were proven by the competitive results of our long-term experiment.
6. Powerful, trained torso among African-American athletes is a factor in their dominance in sprint running and running jumps.
7. The results of our research raise questions about the correctness of the gestalt paradigm of training sprinters, based on the contractile ability of muscles, used by coaches and determine the need to revise the entire methodology of training in fast running.

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