

# BIOMECHANICS IN SPORT

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**Abstract:** *This paper highlights the continuing modernization of the driving technique, and the optimization of the technical preparation of biomechanical parameters in the 110 meter fence race. Through this monitoring technical faults in the event can be objectively established.*

**Key words:** *technical, biomechanics, parameters.*

## 1. Introduction

Today we are talking more about the modernization of the driving technique, about the optimization and rationalization of the means of training. Optimizing the preparation of technical parameters through determining the biomechanics of fence races occupies a conspicuous place in current scientific research

The biomechanical model reflects in the specific training, in the methodology of action, enables the functional anatomy, physiology and biochemistry of biological discovery, and discovers the causes of mechanical phenomena.

Another purpose of biomechanical models is to find objective mistakes occurring during the driving performance, in "crossing fences", to discover the mechanical causes and their effects in the ownership of the rational technique in a rational fence race. Through these biomechanical parameters there can be indicated the measures to be taken in order to obtain a proper technique and different methodological indications that should contribute to this purpose.

In crossing fences, the biomechanism investigated is the movement of the athlete's body, the manner of crossing fences, the cinematic performance and the

athlete's dynamics within this motric action. Using biomechanical modeling of the step over a fence contributes to obtaining an optimal technique and therefore the optimal yield. Without using such a study the objective (i.e. the improvement of the fence-crossing technique) cannot be achieved.

In the biomechanics of the step over the fence every system or subsystem must be analyzed in anatomic-physiological terms in normal conditions. The modeling of this stage is done by determining the elements of the locomotive apparatus, each component of the joint and muscular system, and contributing in this way to the elaboration of the biomechanical model of fence-crossing. The cinematic phase of action can be determined only after the elaboration of this model, and for determination on a very high precision scale one must resort to identifying the instruments, apparatuses and techniques for determining the biomechanical elements that can be used in our country. For example, for the segments' movement are observed the joints, muscles, their moments of inertia by means of regression equations, models and measurements, and in kinematics it is aimed at the execution times, the movement, the speed, the contraction of body segments in space

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using a stopwatch, measuring gadgets, filming flat and three-dimensional, computer simulation – the “moving” device.

So, after their registration, the individual analysis of each cinematic and biomechanical parameter is done.

## **2. Biomechanical Analysis of the Step over the Fence in the Event of a 110 Meter Fence Race**

Running over fences is a complete and independent motric activity, which is repeated cyclically and which constitutes the projection of the body through triple muscle extensions, starting with the contraction of muscles in the lower limb under impulse, and ending with its contact with the ground beyond the fence.

The important characteristic in the event of fence crossing is the rapidity and scraping during jumping over fences. The trajectory of the athlete's body during flight over the fence is a parabola. The smooth trajectory of the parabola depends on the lower limb angle of detachment during the impulsion phase and on the horizontal velocity of the body during the flight. It should be noted that the shape and size are standard, a fact which allows us to determine more precisely the parameters involved in the act.

The fence race technical scheme includes the following:

- Start and acceleration from the start;
- Crossing fences;
- Running between fences;
- The run from the last fence to the finish line.

The start in the race is made from down, which gives athletes the opportunity to speed up in the first 13.72m. to the first fence and to cross it; at this moment, besides the force that the foot imprints upon the soil there is also the horizontal speed, an inertial speed which is imprinted on the body during the flat run. It can be

said that running on flat technique may influence the crossing of fences in the race.

Besides getting the horizontal speed, another important role is played by the muscular tension of the muscular chain triple extension in the lower limbs, both imprinting a flight path as quick as possible. The general trajectory of the athlete's center of gravity when he is over the fence is traced from soil to soil contact. This way its length and height depend on the speed of the mass center and the impulse angle.

The speed the athlete gets from the start moment reduces when jumping over the fence occurs, because there is a small loss of speed when touching the ground (the sole braking foot at ground level), and to these losses there are added some other losses, the results of CGG oscillations of the body. But fence race horizontal speed, maintained as close to the maximum as possible, allows the athlete a more efficient crossing of the fence and a more favorable depreciation to resume the acceleration, in terms of kinetic energy gained.

If at the moment of jumping the trajectory of the body is high, this entails a decrease in high speed gained from running on flat, or if the athlete is running, this time a slight jump over a fence involves a sudden upsurge of CGG and vertical default, including the loss of horizontal velocity and the corresponding adaptation of the renewal of the acceleration after the fence only through additional effort.

This should be avoided, and therefore one should focus on the development of biomechanical models, which contribute more efficiently to the technique of stepping over the fence.

The most effective passage over the fence requires a waiver of the body's CGG and the trajectory of other components involved in the action to perform on a smooth curve.

### **2.1. The Impulsive Phase before the Fence**

At this time, the athlete's body detaches from the ground due to muscle contractions, the triple extension of the lower limbs; to obtain a minimal path from CGG over the fence, the explosive force of these muscles must be used through the coordination of partial impulses, so that the contraction of the muscle groups that perform lower limb extension and planetary flexion should occur at the same time. If the contraction does not synchronize the path segments will be held on the vertical force due to the braking force, and will spend for recovery the kinetic energy obtained from the ground impulse.

This way, the CGG trajectory is achieved due to the force of muscle contraction in the lower limb, followed by the acceleration force of the leading leg and the swing of the upper limbs. This force of contraction makes a horizontal projection of the CGG, a projection that has to be grazing over fences and quick because of the composition of the horizontal velocity of flat running forces that occur at the impulse moment.

During the ground impulse, the inferior limb executes an attack motion on the thigh flexing muscles of the basin, with the role of lifting the inferior limb. If this waiver must have an optimal angle, the attack leg can be found in the first phase of flex knee joint which then extends through a rigorous shank motion forward, a movement which is achieved by femoral quadriceps.

After separation from the ground, the thigh motion is done in the coxo-femoral joint as a result of the positioning of the motor muscles and thigh muscles. The thigh muscles are designed to maintain the vertical position of the torso and to provide

a balance through the basin that offers swing movements.

The optimal flexural angle in which the triple extension attains the best performance is given by the flexible thigh which can be increased to 145 degrees up to contact with the thorax, but this angle varies from sport to sport depending on the segment's size, weight, muscular mass and length etc. This angle is very important because the determination of a fence jumping technique depends on it.

### **2.2. The Fence Crossing Moment**

At this time the jumping foot executes a combined movement represented by flexing the knee and regulated thigh abduction followed by its flexural basin to avoid reaching the fence and make the foot cross the fence. Within this movement there occurs the triple flexion chain of abductors and side rotaries of the thigh. Besides the work of the feet, the upper limbs coordinate movements with the legs, having the role to ensure equilibrium in the phase of flight over the fence.

In this action, the intensity of muscular activity is reduced, but has a well defined role at the moment of landing and in the preparation for acceleration.

### **2.3. The contact Phase of the Foot with the Ground after Jumping the Fence**

This is the phase of landing and return to acceleration, in which the contact of the athlete's body with the running track is made through libatory foot (foot remedies). This phase is intended to cushion the contact with the ground, to reduce the flight speed and to resume acceleration.

At this time the braking force is the body's force because it turns the motor in an elastic spring; this involves the

elasticity and strength of joints, tissues and the running track.

The lower limbs are slightly flexed on the thigh, when the speed reduction is achieved by antagonistic muscle groups (the triple extension), which transforms the foot into a spring and then produces the impulse that gives the start to those three steps between the fences.

The specific biomechanism of jumping over the fence implies the muscular groups and muscular chains representing a dynamic effort.

### 3. Conclusions

Considering biomechanical parameters in monitoring the fence crossing technique, the following must be taken into account:

- Given the high level of performance events at senior international level and the poor one at home, it is necessary at least on the juniors' level to move to the establishment of biomechanical models, ensuring the achievement of such performance.
- Depending on the biomechanical models, competition results will evidence that during a relatively short experiment we will be able to work on modeling effective

training content, achieving and even outrunning the objectives of training and performance.

So, through practical contribution, specialists can access instruments with objective value of correctness in sports technique and increased opportunities to compare the determined athletes to their model of biomechanical fence run.

### References

1. Burcă, I. *Identificarea biomecanică a probelor de alergare și trecere peste Garduri*. Braşov: Publishing House of „Transilvania” University of Braşov, 2008.
2. Donskoi, D. *Biomecanica*. Moscova: Fizkultura and Sport Publishing House, 1971.
3. Iliescu, A. *Biomecanica exercițiilor fizice*. Bucureşti: Publishing House of the National Council for Physical Education and Sport, 1968.
4. Iorga, S.; Bărbuceanu, M. *Biomecanica Sportivă*. Piteşti: Publishing House of the University of Piteşti, 2003.