

# THEORETICAL ASPECTS REGARDING ATHLETICS AND THE EVENT OF THE JAVELIN THROW

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**Abstract:** *Standing out among the other three throwing events, the javelin throw is known to be one of the most spectacular events in the discipline of athletics. It usually takes place in the last two days of major world competitions due to its impressive show and thrilling changes that occur during the six attempts. The aim of this paper is to present the theoretical aspects of this event through the research and study of the published literature and scientific work of the specialists in this field. As the sports domain is one of a large content this paper is a contribution to a dynamic and expanding literature. Athletics and gymnastics are the sports disciplines that lie at the basis of all sports. The throwing technique of this event is constantly improving due to the specialized equipment and the continuous development of the technologies. In conclusion the academic literature is expanding and the theoretical aspects are adapted to the new discoveries.*

**Key words:** *athletics, javelin throw, published literature, technique.*

## 1. Introduction

Athletics is one of the oldest organized form of sports, in the world. It is tracked back to the Ancient Olympic Games and it includes the most basic human activities and abilities such as running, jumping, throwing and walking. It is practiced all over the world and nearly every country participates in the national or international competitions. Along with gymnastics we can say that it lies at the basis of all other sports that were developed throughout the years. In 708 BC, in Greece, the first *pentathlon* is held combining five events running, long

jump, javelin throw, discus throw and wrestling. [6]

Nowadays athletics is also called track and field because of the places, inside the stadium, where the events take place. The three well known groups of events are: running, jumping and throwing, each one with their own set of rules and regulations that need to be respected during a competition.

## 2. Javelin throw, past and present

From the ancient times to the Modern Olympic Games this event has gone through major changes. The length of the

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throw has almost tripled if we compare the early 1800 with modern day competitions and results. In 1906 the javelin throw was introduced at the Olympic Games, for men and in 1932 for women. The spear like object was first made of wood (Figure 1) and then went to several transformations (Figure 2). The Scandinavians took lot of interest in manufacturing the javelin and training in this area that's why for the first three decades of Olympic javelin throwing they were unbeatable. [1]



Fig. 1. *Old Javelin model*  
(source dreamstime.com)



Fig. 2. *New Javelin model*  
(source ebay.com)

The published literature on this topic, of history in this event, indicates that the javelin throw had an ongoing transformation and improvement in so many ways, starting from the implement itself and all the way to throwing technique and equipment as the spike shoes.

### 3. Elements of Javelin tehnique

Authors Brown, Sing, and Webb [5] affirm that "rather than a throw, the javelin is an over-arm, whip-and-flail motion that uses

the entire body." The technique is very demanding and complicated [4] and it requires a lot of motor skills [10], good coordination [12-15] and great forces and speed [2] to maximum accelerate the javelin in the release moment.

The general image of the throw (Figure 3) is made up of four phases:

- The run-up (approach)
- The transition with the crossover steps (multiple strides)
- The delivery/release
- The recovery

The aim of the athlete is to throw the javelin as far as possible with the tip of the implement first reaching the ground.

Specialists in the field, Liebenberg, Zelezny, Ihalainen, Bartonietz [11] support the idea that the key to a long throw lies in the study of ballistics. The movements of the athlete towards the launch, before the javelin is released, is called internal ballistics and the external ballistics is focused on the javelin's flight phase.

The throwing distance is influenced by some important factors and parameters.

- Aerodynamic factors: the javelin, wind, gravity;
- Release parameters: release velocity, release angle, release height, angle of attack, angle of side-slip (yaw), release pitching moment. Release angles (Fig.4).

All of these parameters play a special role in the global image of the throw and the literature in this field emphasizes that the most important one is the release velocity meaning the speed of the javelin in the exact moment when it parts the thrower's hand. This speed is directly related to the force applied to the implement in the release phase.

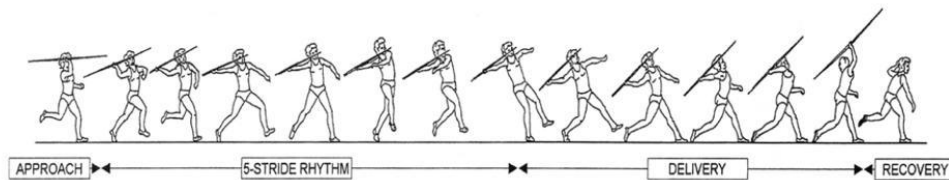


Fig.3. *The general image of the throw* (source majorsportsconsultancy.com)

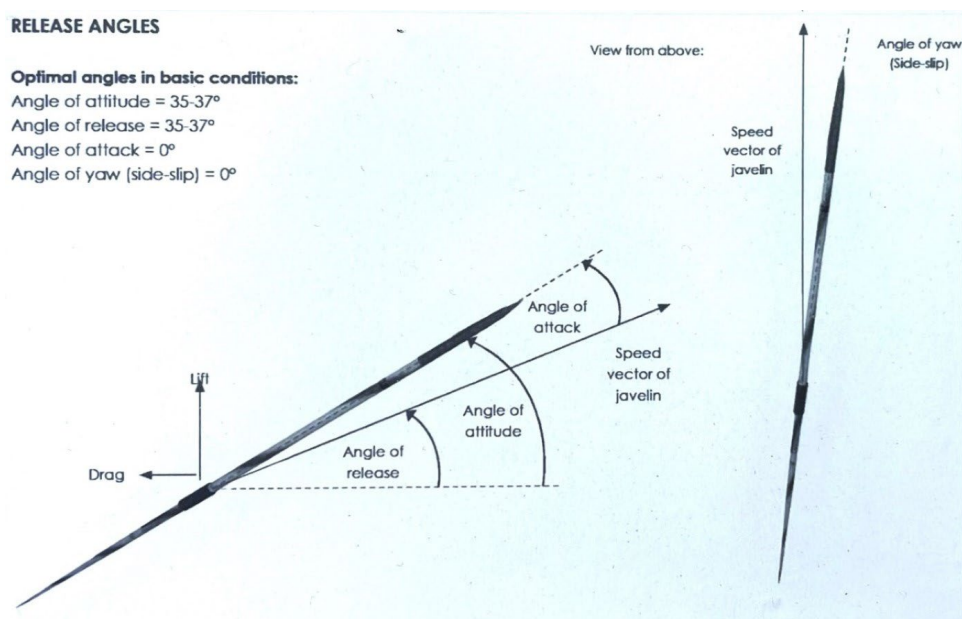


Fig.4. *Release angles of the javelin* [11]

Tables Klaus Bartonietz [3] says that this is „the only parameter that can be maximized by the athlete`s action”.

- Values for elite men: 26-31m/s (meters per second).
- Values for elite women: 24-27m/s (meters per second).

To obtain that high speed a thrower should improve the strength level and power capacities as well as the throwing technique.

The release speed is the sum of the total forces applied to the javelin during the release phase [14] and it is distributed:

- 20% - 30% of final release speed:
  - run-up (approach) speed
  - ground reaction forces
- 70% - 80% of the final release speed:
  - forces generated by muscular contraction
  - distance and time of force application (pulling)
  - action of the support leg
  - hip and shoulder rotation
  - muscular coordination.

The release angles (Figure 4) are explained as following:

- Angle of release: is the angle between the direction of vector of the release velocity and the ground.
- Angle of attitude: is the orientation of the javelin to the ground.
- Angle of attack: is the angle between the longitudinal axis of the javelin and the direction of the speed vector (release velocity).
- Angle of yaw (side-slip) – is the angle of side attack, and it is seen from behind. It represents the angle between the longitudinal axis of the javelin and the speed vector.

The written literature, in the field, states that the velocity of release should be maximized while all the other parameters should reach optimal values.

The weight of the implement differs according to the age groups [8]:

Women age groups:

- U14 – 400g
- U16; U18 – 500g
- U20; U23; Senior – 600g

Men age groups:

- U14; U16 – 600g
- U18 – 700g
- U20, U23, Senior – 800g

### 3.1. The run-up

In the run-up the thrower has the javelin near his head, (Fig. 5) pointed forward, in the direction of the throw, held with the upper arm parallel to the ground and the elbow directed forward, slightly opened to the right. The athlete holds the javelin still,

while running with the shoulders relaxed. It is a cyclic phase with the purpose of building up optimal speed and rhythm and it has an average of 8-12 strides.



Fig. 5. *J. Vetter*  
(source shutterstock.com)

### 3.2. The transition and the crossover steps

In this phase (Fig. 6) takes place the withdrawal of the javelin, the upper body turns to right, with the extension of the right arm backwards, keeping the javelin parallel to the shoulders, and the tip to the eyes level. The legs begin the crossovers steps with the knees and the tip of the toes pointed to the direction of motion. This part is acyclic keeping an optimal rhythm and it has 7-8 strides.

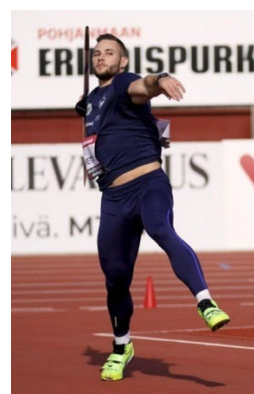


Fig. 6. *J. Vetter* (source shutterstock.com)

### 3.3. The final crossover and stride with the release of the javelin

In this phase (Fig. 7) the direction of the movement is slightly directed to the left. The sequence of the steps is left-right-left. In the double support (both legs) the trunk is tilted backwards, with the right hand extended and the shoulders turned, keeping the same parallel line with the javelin while the left hand is forward.

The right hand is at shoulder height, and the head forward.

In the double support phase, the hips and shoulders rotate to left, the right arm creates a tight bow together with the trunk and the right leg.

The left foot is strongly in contact with the ground creating a blockage and all the momentum built up to this point is transferred from the legs, through the core and in the right arm and finally to the javelin.

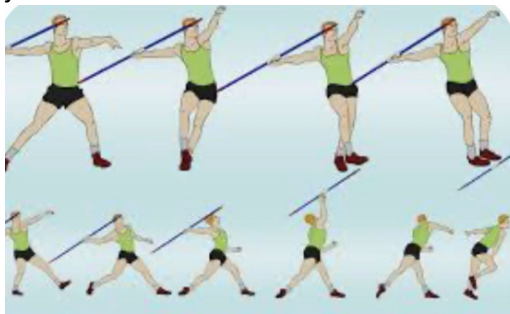


Fig. 7. *The final crossover with the release of the javelin* (source pinterest)

The double support phase lasts about 14-18 hundredths of seconds for the elite javelin throwers and represents the fundamental phase of the throw. In this moment the speed of the javelin gets from 7-8m/s (meters per second) to 31-32m/s even greater. This acceleration is influenced by the rotation of the shoulders from right to left (also called by

the specialists the *opening of the trunk*) and the action of the right arm (which activates at the very end, striking fast with the elbow high) imitating a whip [9].

### 3.4. The recovery

This is the final phase of the throw (Figures 8 and 9). The trunk passes the left leg that was stiffed on the ground. The right leg is brought forward to stop the inertia and the balance is restored keeping in mind to stop before the foul line. Some of the elite throwers have so high ground reaction forces that they drop down on their belly and stop with their whole body.

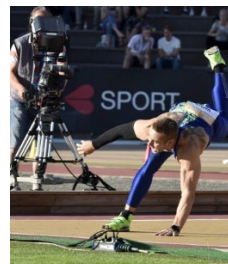


Fig. 8. and Fig. 9. *J. Vetter recovery after throw* (source shutterstock.com)

The global movement of the javelin throw is a complex action and it requires a good general training base and an even greater specific training. Elite javelin throwers have some characteristics that define their performance [14]:

- ✓ High approach speed;
- ✓ Longer final crossover step but immediate, short final step;

- ✓ Stretched right arm backwards that creates a bigger pull distance;
- ✓ Greater ground reaction forces;
- ✓ Stiffer support leg;
- ✓ Earlier hip rotation and at the end of the pull phase the rotation of the shoulder axis;
- ✓ The release of the javelin further, closer to the toes of the support leg.

#### 4. Conclusion

The key to a long throw lies in the study of ballistics. Some of the most important factors in high performance are the release parameters: release velocity, angle of release, release height, angle of attack, angle of side-slip (yaw), release pitching moment. Specialists affirm that the most important one, the one that can be release velocity.

The execution of the javelin throw is a dynamic, smooth, accelerated and high coordinated movement that involves both cyclic and acyclic actions that build up momentum and finish in an explosive whip action that involves the entire body.

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