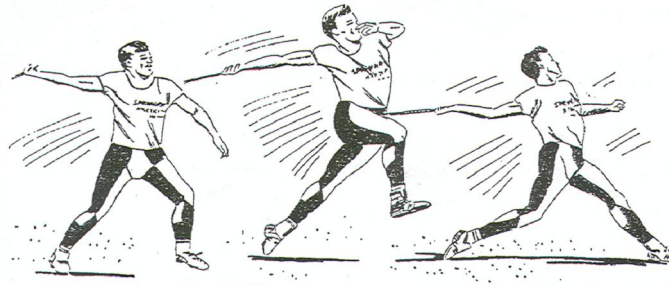


THE IMPULSE-STEP IN THE JAVELIN THROW

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The most important biomechanical principle ultimately determining throwing distance is the release velocity. Greater release velocities will lead the way to longer distances, with all other things being equal.

Release velocity refers to the speed in which the javelin parts with the throwers hand. Elite male throwers reach release velocities between 28 and 31 metres per second. Jan Zelezny, world record holder with a distance of 98.48m regularly achieved release velocities well in excess of 30 meters per second. Coaches and athletes should also realize that an increase of only 1 meter per second in the release velocity will result in an added throwing distance of 4 - 5 metres. Off course the javelin still has to be released at a favourable release angle. Aerodynamic factors will also affect the flight of the javelin.

Release velocity is thus the product of work performed by the thrower. (Work = force x distance). Work takes place when the thrower exerts force on the javelin over a certain distance, and within a certain time span (force x time = Impulse).

The thrower should always attempt to exert the longest possible force on the javelin for as long as possible. The "pull" on the javelin should therefore be long, to also ensure a longer path of acceleration. Hence the long, relaxed throwing arm, "lean back" of the trunk and applying forces through a full range of motion etc.

Coaches and athletes should strive to develop the ability to generate maximal power in the shortest time possible, and this has to be done at higher movement speed. Timing and fine tuning of the nervous system play a crucial role. If this can be accomplished, new horizons can be conquered and even greater throwing distances achieved.

Maximum release velocity implies acceleration, which in turn implies force, and we know that these forces have to be created by powerful muscular contraction.

The different muscles and levers should be utilized in a specific pattern (kinetic chain) and with correct timing. The relevant muscles and levers must contribute maximally to the development of speed, before the next limb is activated (summation of forces).

The slower, more powerful levers and muscles first contribute to the throw, followed by the weaker, but faster levers and muscles, with all the forces culminating during the release of the javelin

Training should therefore be directed towards training the neuro-muscular system. Teaching young throwers the correct throwing technique is paramount, and should always take preference over other aspects, such as the development of strength.

We are also well aware of the fact that there are many things contributing to the release velocity, such as the run-up speed, very quick final left foot contact (right-handed throwers), summation of forces, muscle contraction, correct use of leverage, timing etc. But one should also realise that all of the above are pretty useless if the thrower is unable to attain a good power position, from which he/she is able to accelerate the javelin with great force through a full range of motion. The legs, strong core muscles and firm upper body provide a stable support.

The essential point is that a good power position is very dependent on a good impulse-step (penultimate stride).

The impulse step is not only the vital link between the run-up and the throw, but serves other important functions, such as:

- It ensures that the thrower's feet are ahead of his upper body when the right foot makes contact with the ground at the completion of the impulse-step (fig.1). This will enable the thrower to attain an optimal power position (throwing position).

Fig.1

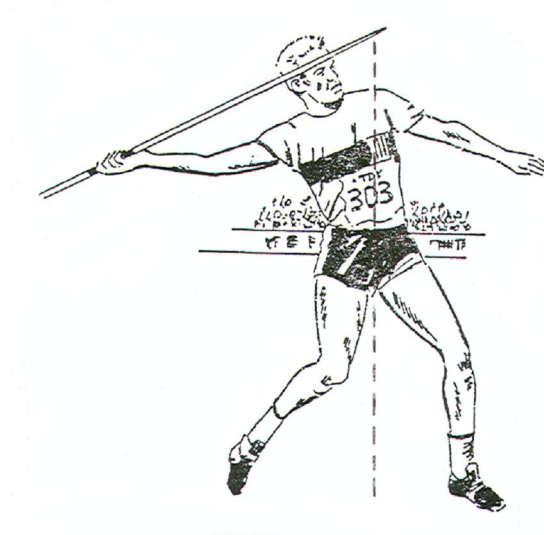


- To attain "lean back", enabling the strong muscles of the trunk and upper body to maximally contribute to the throw.
- It enables the right leg to first contribute to the throw, followed by the right hip, trunk muscles, chest, right shoulder, arm and hand. It also ensures that momentum built-up from the run-up is transferred from the legs, through the hips to the upper body.

Therefore it is also imperative that the throwers core musculature is extremely strong, because all powerful and explosive movements are initiated by the trunk or linked through the trunk. If the core is weak, the whole movement will be weak.

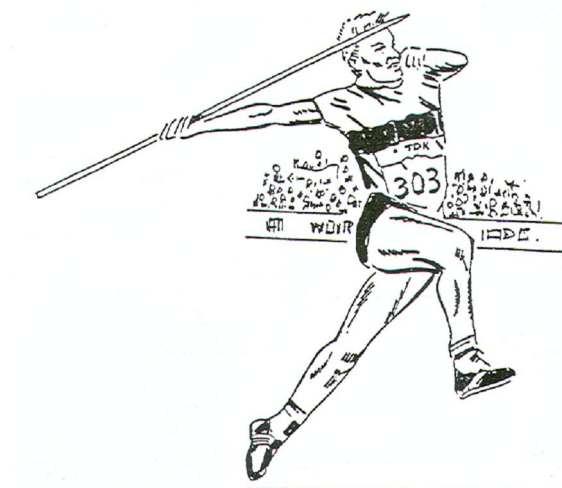
The left leg that introduces the impulse-step should be grounded before the thrower's body passes the vertical plane (fig.2).

Fig.2



This also means that the left leg is grounded slightly ahead of the body's centre of gravity. This will enable the right leg to smoothly and freely accelerate into the throw (fig.3).

Fig. 3



The impulse-step should therefore be:

- fast (accelerate into the throw)
- active
- low

The very active left leg drives the right knee forward. This is accomplished by the thrower "pulling" the ground towards him with his left leg. During the execution of the impulse-step, the left leg should be fully extended, a characteristic of a good impulse-step (fig.3 & 4). The right knee and foot are turned slightly outward (fig. 4). The angle between the lower and upper leg should be larger than 90° .

Fig. 4



(Photo: Getty Images)
Jan Zelezny (Czech Republic)
World Record holder - 98.48m

Previously I mentioned that the impulse-step should be active and low. This is necessary to ensure that the body's centre of gravity is not disturbed and that momentum from the run-up is smoothly carried over into the throw, without any loss of speed.

When the right leg is driven forward, the shoulder axis closes. The left arm wraps across the chest, with the left shoulder rotating inward, and the hand pronating with the small finger of the hand uppermost (fig.4). This position creates a powerful torque and pre-stretch around the hip joint and trunk.

The left leg should be well ahead of the right leg before the latter makes contact with the ground of the completion of the impulse-step (fig.5). Allow the ground to "meet you", instead of you trying to go to the ground. This in turn will ensure that the right leg is in a favourable position to transfer momentum and power into the throw.

Fig. 5



If this cannot be accomplished, the left leg will spend too much time in the air, having a serious detrimental effect on the release velocity. Therefore it is also imperative to get the left leg on the ground almost immediately after the right foot has made contact with the ground at the completion of the impulse-step. The shortest route to the ground should be followed. Jan Zelezny and Andreas Thorkildsen, Olympic and world champions are excellent examples of throwers exhibiting dynamic and fast feet. The time elapsed between the right and final foot contact is approximately 0.75 of a second.

The right leg makes contact with the ground on the ball and outer border of the foot. The right leg is bent to absorb the body weight. The athlete's centre of gravity should be above or slightly behind the right leg (fig.6). The landing should be "soft". This will ensure that the right leg can successfully and effectively contribute to the throw by transferring momentum and power through the hips (core) to the upper body (correct use of kinetic chain), without any loss of speed. The right foot is placed at an angle of approximately 45° to the throwing direction.

Fig. 6



As can be clearly seen the hips are turned sideways to achieve a greater range of motion.

The rhythm of the last three strides should be short-long-short. The impulse-step is therefore longer than the bracing stride (last stride). An optimum ratio for elite male throwers is approximately 1.6 - 1.

The important thing however, is to reach a favourable power position, enabling the thrower to effectively apply force on the javelin through a full range of motion. Jan Zelezny's world record throw however, revealed that his impulse-step was slightly shorter than his bracing stride.

Another point to note is that the athlete should start rotating on the ball of the right foot as soon as it makes contact with the ground. The right knee is pressed forward and down. This will assist to press the left leg firmly into the ground, and to ensure a good base of support (Newton III). This also means that the angle of the bent right leg remains almost unchanged after right foot contact until the release of javelin.

An effective impulse-step is most certainly a prerequisite for long throws and also holds the key to achieving higher release velocities.