THE JAVELIN THROW AND THE ROLE OF SPEED IN THROWING EVENTS

By Peter Ogiolda

German coach Peter Ogiolda presents an analysis of the different phases of the javelin technique and examines the importance of velocity in the final phase of the javelin throw. The article is an edited version of the author's lecture at a Seminar held in Stuttgart, Germany in 1993 and reprinted from New Studies in Athletics, Vol. 8, No. 3 September 1994. The translation from the original german is by Jurgen Schiffer. Re-printed with permission from Modern Athlete and Coach.

INTRODUCTION

The throwing events in athletics, including the javelin throw, can be said to be acyclic movement exercises performed at maximum speed. Because of its contribution to release velocity, which is the key to achieving maximum throwing distance, speed is the essential prerequisite for success in these events. The purpose of this article is to give an overview of the javelin throw by examining in some detail the role which speed plays in the event. We will:

- Define speed and its contribution to all throwing events;
- Analyze the different phases of the javelin throwing movement;
- Examine the importance of velocity in the final phase of the javelin throw;
- Discuss some implications for talent selection for the javelin throw.

THE ROLE OF SPEED

According to the laws of physics, release velocity has the greatest influence on distance attained in any throwing event. This is both a guiding and target parameter. *Therefore, release velocity should always* be *maximized while the values of the other factors should be optimal.*

When we use the word speed we are speaking in terms of acceleration, velocity, frequency, and time of reaction to a signal.

Achieving high release velocity values in any throwing event requires great accelerations and velocities of the body's kinetic chain. In other words speed.

To be even more precise, we can add that there is an element of strength required for dealing with the mass of the various implements. Thus ‘speed strength’ is the clearest term for the most important prerequisite in the throwing events.

THE PHASES OF THE JAVELIN THROW

Division of the Javelin Throw

The javelin throw can be divided in different ways. Firstly, we can talk about three successive acceleration phases:

- Acceleration of the whole thrower-javelin system using the speed and strength of the legs;
- Acceleration of the thrower’s trunk. By bracing the lower parts of the body (great mass) energy is transferred to the upper parts of the body (small mass), thus causing them to accelerate;
- Acceleration of the thrower’s arm and hand and the javelin. By bracing the upper parts of the body the energy is transferred to the lower arm, hand and the javelin. This leads to a further increase of velocity.

Secondly, we can talk about movement structure and divide it for training purposes. This division would include the most important characteristics of the beginning and end of each movement phase, information about the biomechanical function of the individual phases, and finally, the characteristics of the whole movement.

Thirdly, we can look at the three movement phases which contribute to release velocity:

- The cyclic section of the approach — an acceleration run consisting of 8 to 12 strides (velocity... 6 to 7 m/sec);

- The acyclic section of the approach characterized by a five-stride-rhythm where the length of the impulse stride for women is about 1.60 to 1.90 meters and for men about 1.80 to 2.00 meters;

- The final acceleration phase.

All phases of the throw fulfill certain necessary functions. However, their main function is to develop sufficient velocity and to transfer this velocity to the next movement phase. The whole throw movement should be characterized by a progressive increase in velocity with maximum velocity achieved as the javelin is released.

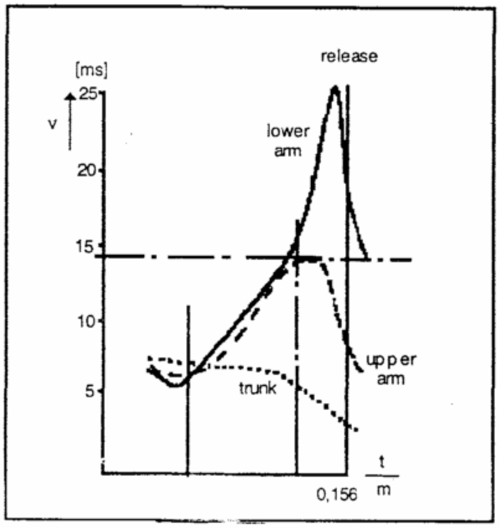

FIG. 1: *Successive movements of body segments in the javelin throw. (Uwe Hohn: 99.52m)*

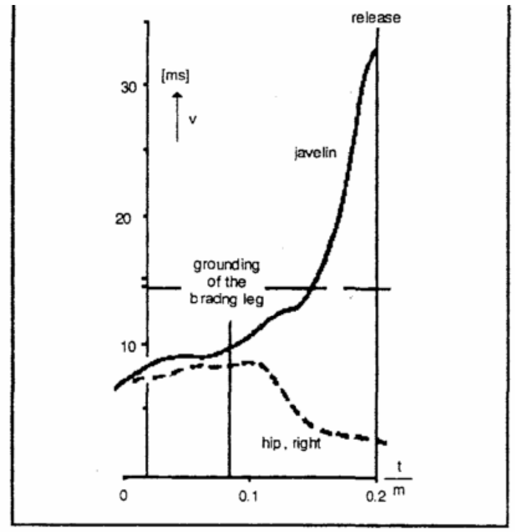

FIG. 2: *Velocity-time curves of the movement of the Javelin and the hips (Uwe Hohn: 104.80m)*

Movement of the Javelin and Body Segments

Figures 1 and 2 illustrate the timing and speed of the successive movements of body segments. The speed curves of these movements show a continuous increase in velocity, until maximum velocity is achieved at the moment of release. Release velocities in the javelin can reach the following values:

- Men: about 32.00 m/sec (x 3.66 = 115 km/h)
- Women: about 28.00 m/sec (x 3.6 100 km/h)

Because of its extraordinary importance, I now want to deal with the final acceleration phase in more detail. I will do this by referring to information and results from research reports of the former Research Institute for Physical Culture and Sport (FKS) in Leipzig which have only recently been made available.

THE FINAL ACCELERATION PHASE IN THE JAVELIN THROW

Beginning and End of the Final Acceleration Phase

The final acceleration begins with the active use of the right leg before the left leg is grounded. It ends after the javelin has left the thrower’s hand. This movement phase is presented in Figure 3.

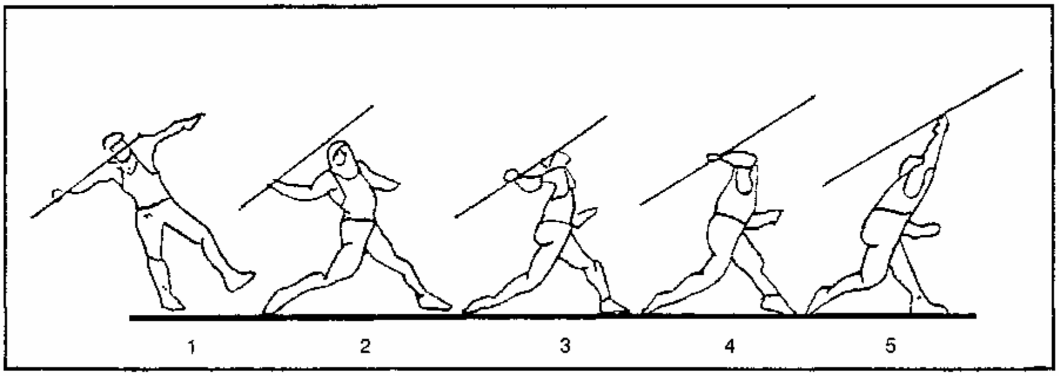

FIG. 3: The final acceleration phase

Description of the Final Acceleration Phase

The release movement is initiated by the activity of the right leg, which — corresponding to the coordination pattern of the javelin throw — accelerates the thrower's hips.

When the extended left leg is grounded in a bracing action, the movement of the left leg and hip stops immediately. In other words, the body's own "abutment" is being used.

The right side of the body reacts to this braking of the left side by rotating approximately 90 degrees about the left side, as far as is permitted by the second "abutment", which is the gliding contact of the right foot. The movement of the right side of the body is forwards and upwards, the aim being to get under the javelin with the extended throwing arm.

Both the left and the right "abutments" transfer the initial moment of impact (grounding of the left leg) to the thrower's upper body, particularly to the shoulder of the throwing arm. At this point the thrower shows an extreme bow or shoulder tension which can be seen in the third position shown in Figure 3.

By deliberately holding back the throwing arm, the performance determining key position — characterized by the stretched muscles of the arm and shoulder (stretch-shortening cycle) — is achieved. This initiates the reflex component of the muscle action which reaches its peak in the release movement and produces the major part of the acceleration of the javelin. (More than two thirds of the release velocity is realized in a tenth of a second through the throwing arm and more than half of the release velocity is realized in a twentieth of a second through the slinging movement of the lower arm.) This acceleration is even increased by physiological, biochemical and neuromuscular influences.

The Ideal Acceleration Curve

Performance diagnosis, using the tensojavelin and laser light barriers, and the evaluation of the data produced by both measurement systems has produced acceleration curves. By the systematic measurement of many javelin throws made by athletes of varying ability levels at different times of the year and over a period of several years, it has been possible to plot final phase acceleration curves for each thrower and an ideal final acceleration curve (which is shown in figure 4). It is possible to interpret and compare individual curves with the ideal acceleration curve.

The following factors emerge from analysis of the ideal acceleration curve:

- The course of any thrower's curve can easily be compared to that of the ideal curve;

- The area between the curve and the x-axis gives information about the total impulse, which is Fxt;

- The distance from the peak of the curve to the abscissa is a measure of the acceleration force, which is Fmax;

- A steeper rise of the acceleration curve means the maximal value of the acceleration force is reached faster.

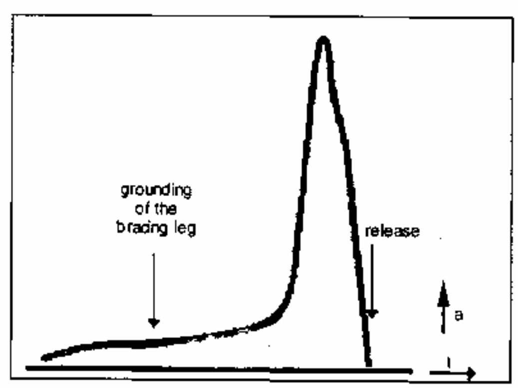

FIG. 4: Ideal acceleration curve

To summarize, all these aspects of the acceleration curve demonstrate the connection between good technique and a speed-strength ability that is specific to the javelin throw.

Comparison of Acceleration Curves

A comparison of the curves presented in Figure 5 with the ideal acceleration curve shows that the selected athletes from the former GDR get very close to ideal javelin throwing technique.

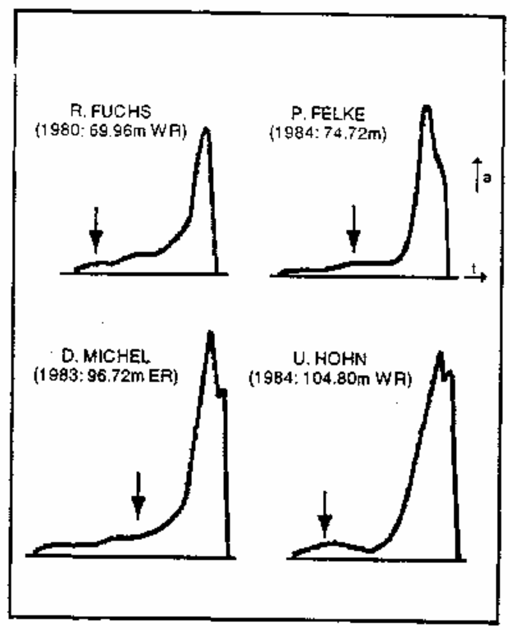

FIG. 5: Acceleration curves of throws by leading GDR throwers. (The arrows indicate the grounding of the bracing leg)

The curves produced by Petra Felke and Detlef Michel are examples of good modern technique. Both curves show that a high level of speed-strength has been optimally translated into javelin throw movements.

When we compare the curve of Ruth Fuchs with Felke we see clear differences. Felke had more speed-strength ability than Fuchs. That is why Felke's total impulse and absolute acceleration force value was higher and the rise of her curve steeper than they were for Fuchs. This means that Felke had greater explosive power than Fuchs.

Uwe Hohn's curve shows that, in spite of his excellent personal best mark of 104.80m with the pre-1986 specification javelin, his throwing technique had room for improvement.

It is interesting to note the curves for throws by Felke over a four year period. Their improvement demonstrates the systematic buildup and realization of a successful training concept based on:

- Knowledge of the 'ideal' target technique.

- Regular technique analysis consisting of a comparison between Felke's current technique and the ideal technique. This comparison permitted the identification of technical faults, i.e. deviations from 'ideal' technique, and led to modification of training.

- Methods of technique training, which permitted the successful development of the 'ideal' technique.

The curves demonstrate how Felke's throwing technique has changed over the course of several years. The curves also show that it is possible to get very close to the 'ideal' technique if training is consistent and accompanied by regular analysis of technique.

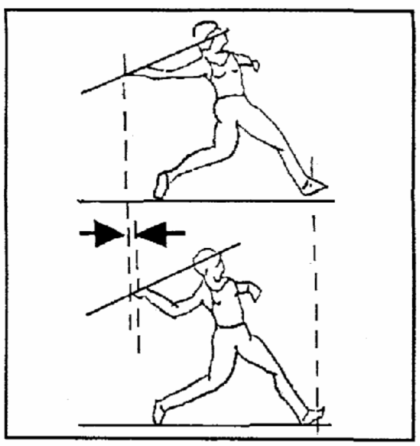

FIG. 6 a: Example of 'bent throwing arm'

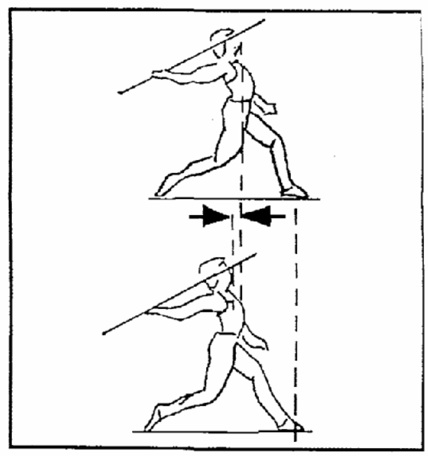

FIG. 7 a: Example of 'bent bracing leg'

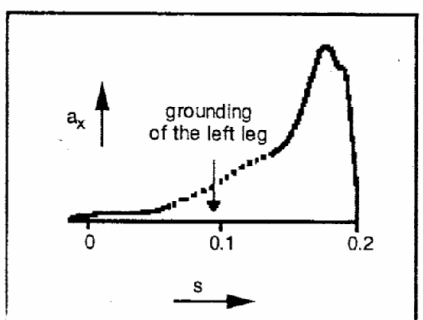

FIG. 6 b: Acceleration curve in the case of a bent throwing arm

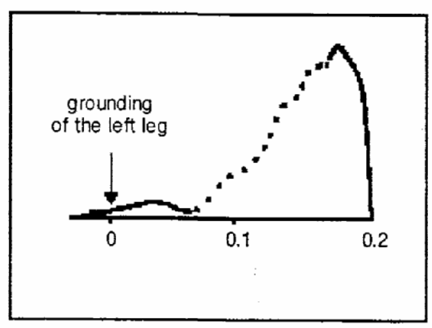

FIG. 7 b: Acceleration curve in the case of a bent bracing leg

The aspects of the development of Felke's curves which should be noted are:

- The total impulse, Ext (the area between the curve and the x-axis), increases;

- The absolute value of the acceleration force increases;
- The maximal value of the acceleration force is reached faster because of the steeper rise of the curve.

Comparison of Typical Faults in the Final Acceleration Phase

Two typical faults of the final acceleration phase of the javelin throw are a bent throwing arm and a bent bracing leg. Both faults will hinder athletes in their efforts to reach maximum throwing distances and both are visible to the naked eye.

Figures 6 and 7 illustrate the effects of these faults. Even the starting sections of the curves indicate that the thrower is about to make one of these main errors. Normally, when this happens, the thrower has no chance of returning to the ideal acceleration curve.

If athletes consistently throw with a bent bracing leg and throwing arm, there is more risk of injuries to the elbow of the throwing arm. This is especially true if the elbow of the throwing arm is too far below the shoulder axis during the throwing movement as this causes throwers to produce sideways instead of over-arm throws.

If possible, advanced javelin throwers should learn to make instinctive judgments about what is likely to be a ‘bad’ throw and be ready to stop attempts during the preliminary phases — especially if both faults occur simultaneously — in order to prevent worse movements.