Biomechanical Analysis of the Shot-Put Event at the 2004 Athens Olympic Games

By

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Introduction

The Shot Put competition at the 2004 Athens Olympiad was held in the Ancient Olympia stadium. This was the site of the ancient Games of the Olympiad, 2,800 years ago. Despite skepticism from the rest of the world, the organizers of the Athens games did so many things right and nothing exemplified this more than holding the shot put competition at Olympia. In a games already steeped in history, the organizers thoughtfully connected the ancient and modern Olympics in a serene setting that was so unusual that it will probably be remembered as one of the highlights of these games whenever they are recalled.
Purpose of the Study

The purpose of this study was to analyze the best shot put performances in the Athens 2004 Olympic Games. Multiple high speed digital video cameras were placed in specific locations on the field at proper angles in order to capture the performance of the athletes in the preliminaries and finals. Two stationary cameras were placed at 45 degrees to each other. In addition 3 more cameras used by the NBC broadcasting were used to assist the other 2 cameras. Temporal and kinematics variables were calculated from the videos records and were analyzed yielding three-dimensional biomechanical results. Kinematics parameters for the best 3 final performers were presented in this study.
Methods

• Multiple high speed digital cameras (60 fps) were used to collect videos of the shot put performers in the 2004 Olympic Games. All throws at the preliminaries and final performances were recorded. Videos collected were transferred automatically to two notebook computers via IEEE1394 interface PCMCIA cards, and synchronized to produce trimmed files representing the complete throws. The trimmed videos from each performer were transmitted through the Internet to a server in order to distribute the data to multiple locations for analysis. All the video digital cameras recorded at 60 fields per second.

• Dimensions of known factors and various other measured objects in the field of view were used for the calibration points. Since it was impossible to place a pre-measured calibration frame in the field for security reasons, known measurements on the field as well as utilizing the athletes’ body dimensions were used.
Biomechanical Wizard

www.sportsci.com/wizard
Belonog Shot-put Velocity Curve
Nelson Shot-Put Velocity Curve
Olson Shot-Put Velocity Curve
Release Angle (deg.)

Belonog: 33
Nelson: 33
Olson: 41
### Selected Kinematic Performance Parameters of the Top Three Throwers

<table>
<thead>
<tr>
<th>Performer</th>
<th>Place</th>
<th>Distance m</th>
<th>Release Height m</th>
<th>Shot Velocity m·s$^{-1}$</th>
<th>Release Angle Rad (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuriy Belonog</td>
<td>Gold (1)</td>
<td>21.16</td>
<td>2.55</td>
<td>13.85</td>
<td>.58 (33)</td>
</tr>
<tr>
<td>Adam Nelson</td>
<td>Silver (2)</td>
<td>21.16</td>
<td>2.33</td>
<td>13.95</td>
<td>.58 (33)</td>
</tr>
<tr>
<td>Joachim Olsen</td>
<td>Bronze (3)</td>
<td>21.07</td>
<td>2.31</td>
<td>13.60</td>
<td>.72 (41)</td>
</tr>
</tbody>
</table>
Belonog
Belongog Winning Throw
Nelson Best Throw
Belonog – Nelson comparison
Angular Momentum for left Thigh and Shank

Belonog

Nelson
Discussion: The shot put distance depends on a variety of factors. The angle in which the athlete can achieve the optimal acceleration of his/her arm segments would represent an optimized performance. Factors that influence optimal performance would be the release height, release velocity, and release angle. Segmental acceleration depends on the technique that allow optimal combinations of the above parameters. Nelson and Yuriy both obtained the same throwing displacement, but Nelson was able to generate 7.2% faster shot projection velocity with 9.4% lower release height, and both competitors putted at the same projection angle. From the present analysis it was determined that Adam Nelson was closest to achieving optimal performance for his movement parameters.
What is wrong in this movement?
You cannot shoot a cannon out of a canoe