COMPARATIVE ANALYSIS BETWEEN LOW, MEDIUM AND HIGH LEVEL HAMMER THROWERS

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INTRODUCTION: The hammer throw is characterised by the complex spatial structure of the action, where to achieve the maximum final velocity of the hammer is necessary to make two or three previous "winds" of the hammer followed by three, four or five turns, while simultaneously the thrower-hammer system moves lineally across the throwing circle. All this is complicated further by the change in spatial orientation of the plane that defines the pathway of the hammer in each turn. This fact, together with the relatively long time used to achieve the final hammer speed, makes it difficult to analyse the factors that influence the distance of the throw, so that various solutions among them are possible. Taking into account the product factors which determine the distance of the throw, the tangential velocity of the hammer head at the end of throw will be determined by the increase in speed of each turn, a rate of increase that is individual for each thrower. It should reach its maximum value at the instant that the thrower releases it, when the projection angle will be conditioned by the inclination plane of the hammer in each turn, the thrower's final action and the height of release. Other relevant aspects involved in hammer throw are the positions adopted by the thrower in each turn (double and single support phases), the radius of the turn, the change of the resultant angular momentum, the hammer's plane of inclination to the horizontal, the displacement of the thrower's centre of gravity across the throwing circle. The main aim of this work has been the development of a comparative analysis between the main biomechanical factors obtained in three different groups of hammer throwers. This knowledge can help to hammer throwers and their coaches for improving training methodologies in early stages of training (beginners).

METHOD: We establish three groups of hammer throwers: Low level (8 young well trained Spanish athletes, height x=1.78 m ±0.07 SD, weight x=81 kg ±3.4 SD), Medium level (8 best Spanish throwers, height x=1.83 ±0.05 SD, weight x=89 kg ±4.7 SD) and High level (8 best World throwers filmed in Seville'99 Athletics World Championships, height x=1.82 ±0.08 SD, weight x=91 kg ±4.4 SD). That athletes were filmed in competition conditions. For the development of this work we have used the traditional 3D photogrammetric methodology, using a software called "CYBORG" (version 3.0) developed in our laboratory. The filming were done using two video cameras of 50 frames per second, with a cube as a reference system for 20 points distributed in the throwing circle. After digitising the hammer thrower model (23 points), the cameras were automatically synchronised using special algorithms developed in our lab. After the synchronization, the coordinates were smoothed using quintic splines, and finally the three-dimensional coordinates were obtained using DLT algorithms.

RESULTS: Different kinematic and kinetic parameters were obtained for the individual, intragroup and intergroup analysis, using graphics and statistic.