

https://dspace.org/

Characterizing the influence of a prosthesis on the shot put movement

Boulle, Nathanael

2021
https://hdl.handle.net/10539/33001

Downloaded from a DSpace repository. https://dspace.org/

Abstract

Competitive able-bodied athletes have shown to benefit from biomechanical analysis. However, there is a paucity of research into the movement science of disabled athletes and uncertainty as to whether the biomechanical principles of able-bodied athletes can be applied to disabled athletes. This is true for competitive shot put, which is the focus of this study. This investigation seeks to provide principles for improved shot put outcomes for an athlete using a lower limb prosthesis, and determine whether able-bodied literature can be applied to disabled movement science for the shot put movement. The main biomechanical principles of able-bodied shot put athletes are concerned with segment velocity, centre of gravity (CG) profile, feet sequencing and trunk rotation. Motion data was collected using a Xsens MVN Analyze motion capture system and ground reaction force data was collected using a FDM pressure walkway. The captured data was used to articulate and validate a rigid multibody model developed in Simscape Multibody, a simulation environment provided by MATLAB. The model was lower body specific and computed results including combined segmental velocity data, joint torques, normal forces and frictional forces which were not offered by the motion capture system. The simulation was validated using measured displacements from the Xsens motion capture system as well as measured ground reaction forces measured using the pressure walkway. The principle investigation (Section 7) emphasizes the importance of, and provided mathematical parameters for, the initial glide of the preamble as well as the delivery stride, which are the two primary movements in shot put. Significant areas of influence for the prosthesis are characterized by a reduced delivery stride width, impaired sequential muscle activation and difficulty in providing an effective base from which the upper body segments can extend. The evidence of the investigation indicates that the utilization of able-bodied movement principles is useful in disabled sports science. Moreover, due to this correlation of the the disabled athlete with able-bodied counterparts, the shot put principles can be observed as fundamental theory for any given shot putter, or by extension any projectile based sport.