A KINEMATIC ANALYSIS OF TEN-PIN BOWLING TECHNIQUE OF ELITE BOWLERS

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INTRODUCTION

Ten-pin bowling is a sport where technical skills are very important. In 2010 it was estimated that 166 million people, in over 90 countries, play the sport of bowling [1].

Research in ten-pin bowling is mostly limited to the equipment and physiological parameters [1,2], while the kinematics of bowling has hardly been studied. Only a few studies have investigated the kinematics behind the bowling technique with 2D analysis [3].

Due to the lack of scientific analysis and thereby the understanding of the bowling kinematics, the purpose of this exploratory study was: To achieve a better understanding of the modern bowling technique through 3D motion capture. In particular, the focus was at the evaluation of the joint angles in the supporting leg, acceleration of the swing hand, the wrists movement, as well as the body's vertical movement through a throw.

METHODS

Nine Danish elite world-class male bowlers were recruited (Mean±SD, age: 27.3 ± 6.1 years; body mass: 84.5 ± 10.1 kg) to perform 20 bowling strokes. Kinematic data was recorded using a Xsens MVN link 3D motion capture system (Xsens Technologies B.V, Enschede, The Netherlands) at 240 Hz.

The subjects performed 20 throws on the 10 pin lane. The objective was to tilt as many pins as possible.

The collected variables were Knee-, ankle- and hip joint flexsion/extension for the support leg, resulting acceleration and vertical position of the swing hand, the swing hand wrist movement in ulnar deviation/radial deviation, pronation/supination and flexion/extension. Moreover, the L5 joint vertical movement was recorded.

RESULTS AND DISCUSSION

The Xsens MVN link was successfully used to collect kinematic data of the bowling technique. Figure 1 shows the group mean for all subjects. The top position of the hand, in the backwards swing, was found and 480 frames before and after the peak were utilized.

The results of the bowling technique analysis showed that the bowlers deliver the ball after the lowest point in a lift just prior to ball release. Knee and hip joint extends prior to ball release causing the body to move upwards. Further, the analysis did reveal that elite bowlers are highly consistent in their movements.

CONCLUSIONS

This study is the first that describes the technique in ten-pin bowling. Thereby, the study has increased the understanding of joint angles in the support leg, kinematics of the swing hand and the vertical displacement of the trunk. The Xsens technology based on inertial measurement units provides a mean to assess bowling technique away from the laboratory and out in the field.

ACKNOWLEDGEMENTS

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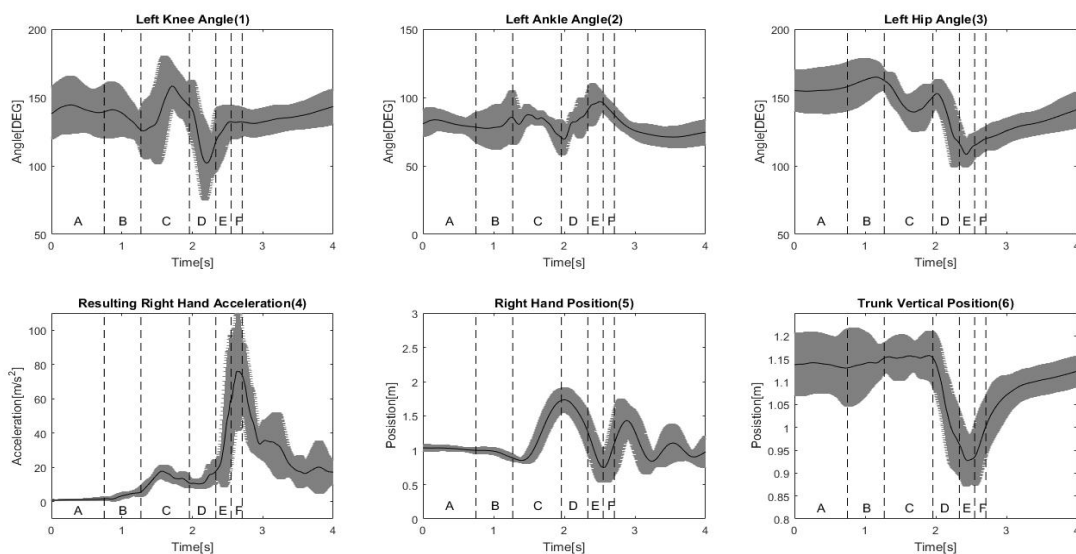
Figure 1: Group mean for all subjects: knee, ankle and hip angles as well as swing hand in vertical position and the resulting acceleration. Lastly, the trunks' vertical position. Different phases of the bowling stroke have been marked. **A:** Initiation of the third step. **B:** Initiation of the fourth step. **C:** Top position in the backwards wing. **D:** The forward motion of the ball begins as well as initiation of the fifth step. **E:** The ball reaches the lowest point in the swing and the left foot starts to slide **F:** Delivery of the ball to the lane.