IDENTIFYING CRITICAL KINEMATIC PARAMETERS FOR BETTER GOLF PUTTING

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INTRODUCTION: In modern golf competition, putting is one of the crucial parts of the game. It has been reported that putting accounts for about 40% of all golf shot played in tournaments (Gwyn & Patch, 1993). Wiren (1992) also indicated that, on average, putting constitutes 38% of all golf strokes in competition and improving putting skills is the fastest way to lower the score. However, it is also true that most recreational golfers neglect the putting and seldom practice it hard. Despite this revealing statistics and the obvious importance of competent putting, much of the pedagogical literature is based on the observations and anecdotal evidence provided by top players and coaches (Paradisis & Rees, 2004). Therefore, the purpose of this study was to identify critical kinematic parameters of a putt by comparing putts performed by elite and novice golfers, and non-golfers. The findings might provide valuable information for improving putting performance.

METHODS: The participants consisted of three groups based on their playing ability: 5 elite golfers (handicap ≤ 2), 5 novice golfers (handicap ≥ 25), and 5 non-golfers (never played before). All of them were male subjects. A 1 m $\times$ 10 m artificial putting surface was set up for the experiment. A 3D motion analysis system (Motion Analysis Corp., USA) with 6 high-speed Falcon digital cameras was used. A total 30 markers was placed on subject's body and 4 markers on the putter. Before collecting data, each subject was allowed to practice. After the warm-up, 3D data (120 Hz) was collected for each subject performing 5 trials of putts from each of these distances: 1 m, 3 m and 5 m. A 4th order zero-lag Butterworth filter was used for noise removal. An optimal cutoff frequency was calculated based on the residual method. Position data were differentiated with respect to time to obtain velocity, acceleration and jerk using the finite difference method. The putting stroke was divided into back swing, through swing, and follow through phase. Dependent variables will include timing variables, displacement (for movement), velocity, and jerk (for smoothness) characteristics for different phases. Data will be analyzed using minimum-jerk theory and ANOVA statistics.

RESULTS AND DISCUSSION: Significant differences in selected kinematic parameters are expected among elite, novice, and non-golfers. Although the overall duration of a putt could be longer as the putting distance is increased for all three groups, we anticipate that the elite group will take longer time during the back swing phase and shorter time during the the through swing phase than the other two groups. The displacement of putter during the back swing phase is also expected to increase with increasing putting distance for the all groups and the elite group will move farther than the other two groups. Other kinematic parameters such as velocity and jerk will be identified to differentiate these three groups. Specifically, since the elite group is the most proficient in putting the jerk value will be minimum to show the smoothness of the movement when compared to the other two groups.

CONCLUSION: The results provide insights into the stroke mechanics of putting used by elit e golfer and such information will be useful resources for the instruction of putting.

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