

ANALYSIS OF ELITE AND NOVICE DISC GOLFERS PERFORMING 10 M PUTTS

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INTRODUCTION

There are primarily three different throws in disc golf (the drive, the approach, and the putt) each requiring a different pattern of movement. The putt is a shot unique to disc golf which is generally selected by elite disc golfers when the disc falls within 15 m of the basket. Since it requires a great deal of control, accuracy, and is a somewhat slow movement, an assumption might be made that the expected mode of timing would be simultaneous (Kreighbaum and Barthels, 1981; Putnam, 1993); however, in order for the disc to spin, it would seem that the distal movements of the wrist would need to be incorporated, thus comes the aspect of velocity generally associated with sequential intersegmental coordination (Putnam, 1991). Bird et al. (1991), when investigating the intersegmental coordination of a badminton deep serve which requires both accuracy and velocity, found that the advanced player utilized the proximal-to-distal sequencing pattern of intersegmental coordination. However, throwing a disc into a basket 10 m away may place an even higher demand on accuracy, and the purpose of this study is to conduct a descriptive kinematic analysis of elite and novice disc golfers performing 10 m putts.

METHODOLOGY

Four right-handed subjects (two elite, male and female and two novice, male and female) were filmed performing ten putts in the sagittal, frontal, and transverse planes using a video camera operating at 60 Hz with a 1/500 s high-speed shutter. The elite male disc golfer was ranked 17th in the world with a 12th place finish at the 1992 World Disc Golf Championships, and the elite female disc golfer was the 1992 Women's Rookie of the Year. Both of the novice performers were athletic, engaging in competitive tennis, cycling, and/or running, but they had little to no disc golf experience and limited frisbee throwing experience. How close, if the disc went in and then out of the basket, whether the disc hit part of the basket, or if the disc fell in the basket was recorded for each trial. The best of the ten trials for each performer in each of the planes was then analyzed using the PEAK Performance 2-dimensional movement analysis system interfaced with a Panasonic AG-7350 recorder, Sony PVM-1341 monitor, and Zenith 486 microcomputer. The data were smoothed using a fourth order, zero lag, Butterworth digital filter. After selecting the best trial based on performance and clarity of the film, digitizing began when the subject started bringing the disc back for the putt.

RESULTS and DISCUSSION

The results of the ten trials are presented in Table 1. It should be noted that how close the disc lands to the basket in the event of a miss is very important in that it will determine how far a person must putt for the next shot. Therefore, in the six trials where the elite female disc golfer hit the basket, she left herself an easy next shot where the novice female did not on her eight misses.

Table 1. Putting results of ten trials at the basket from 10 m.

		Made	In/Out	Touched	Missed
Male	Elite	4	3	1	2
	Novice	0	0	0	10
Female	Elite	1	1	5	3
	Novice	2	0	0	8

For the horizontal and vertical displacements of the center of mass in the sagittal plane, the elite female (EF) had greater horizontal displacement and acceleration ($M=2.96 \pm 0.07$; $M=0.49 \pm 1.23$) than did the novice female (NF) ($M=2.16 \pm 2.00$; $M=0.35 \pm 2.40$). The same was true for the elite male (EM) ($M=2.81 \pm 0.06$) versus novice male (NM) ($M=2.38 \pm 0.09$; $M=0.44 \pm 1.70$). Both NF and NM exhibited greater horizontal velocities ($M=0.76 \pm 0.30$; $M=0.16 \pm 0.42$) than did the EF and EM ($M=0.04 \pm 0.32$; $M=0.08 \pm 0.32$), respectively. The elite performers (EF and EM) had less vertical displacement ($M=1.59 \pm 0.06$; $M=1.64 \pm 0.03$, respectively) but greater vertical velocity ($M=0.09 \pm 1.23$; $M=0.08 \pm 0.27$) than did the novice ($M=1.92 \pm 0.02$; $M=2.22 \pm 0.04$) ($M=0.03 \pm 0.29$; $M=-0.021 \pm 0.18$), respectively.

From the frontal view, the horizontal and vertical displacements, velocities, and accelerations of the center of mass were calculated. Both the novice performers had greater vertical displacements and horizontal velocities than did the elite. However, the elite performers exhibited greater vertical velocity. The novice female had the greatest horizontal displacement ($M=2.42 \pm 0.02$) of all the subjects (EF, $M=2.07 \pm 0.02$; EM, $M=2.27 \pm 0.02$; NM, $M=2.02 \pm 0.02$).

The angular velocities showed simultaneous intersegmental coordination of the shoulder and elbow are clearly demonstrated which agrees with the literature concerning the movements with high accuracy demands (Kreighbaum and Barthels, 1981). Figure 1 presents the angular velocities of the arm joints for both the elite and novice males. Also, the distal or serial movements of the wrist just prior to release indicated that the putt incorporated both simultaneous as well as sequential intersegmental coordination. Although the novice male demonstrates the simultaneous movements of the shoulder and elbow as well as the distal movements of the wrist, when compared to the elite male, it was evident that the novice has many more extraneous movements.

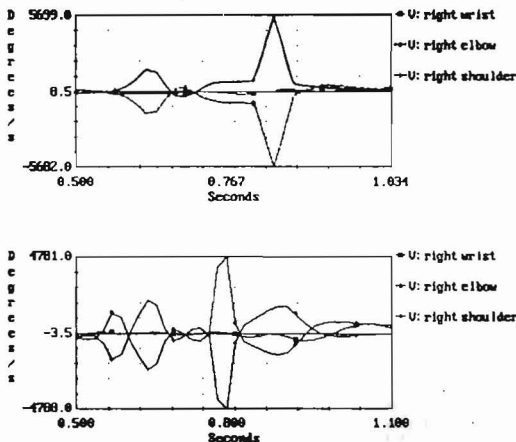


Figure 1. Joint angular velocities of the elite male (top) and novice male (bottom).

The angular velocities of the elite and novice females are represented in Figure 2. Obviously, the movement was not a simultaneous one; however, when compared to the elite female it can be seen that this was not a jerky and/or uncoordinated movement. The movement was more representative of sequential intersegmental coordination generally exhibited by the skilled in curvilinear or high velocity movements (Putnam, 1991). This subject was a competitive tennis player, and her putt looked very much like a backhand.

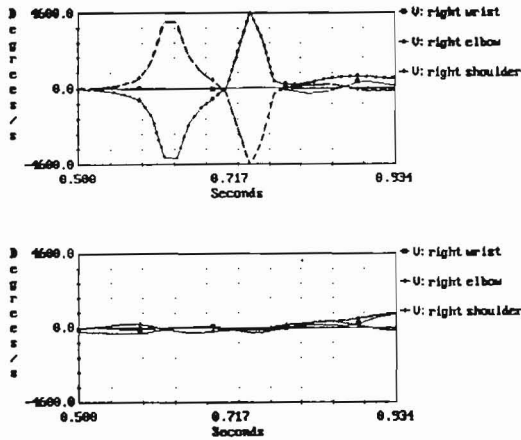


Figure 2. Joint angular velocities of the elite female (top) and novice female (bottom).

CONCLUSIONS

In conclusion, it was found that the elite disc golf subjects moved primarily in the sagittal and horizontal plane when putting and had less movements in the frontal plane than the novice. Also, elite performers demonstrated a high degree of simultaneous intersegmental coordination as represented by the movements of the shoulder and elbow, along with sequential intersegmental coordination, as shown by the distal movements of the wrist just prior to release. The novice male, while demonstrating simultaneous movements of the shoulder and elbow as well as distal movements of the wrist, had extraneous movements. Finally, although the novice female demonstrated a smooth, perhaps sequential pattern, she sacrificed much accuracy.

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