THE COMPARSION OF EFFECTIVENESS BETWEEN GRAB START AND TRACK START IN COMPETITIVE SWIMMING

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INTRODUCTION

Performance in competitive swimming is influenced by swimmer's physique, strength and endurance of muscle factors, etc., but the most important and key factors are swimming techniques, including stroke, kick, turn, touch wall and start. The time a swimmer spends in the start ranges from 0.8% to 26.1% of the overall race time, depending on the event [1]. So the shorter the race distance, the more important the effect of the start. Many starting techniques are used in competitive swimming, such as the grab start, track start and swing start. The grab start and track start are the most popular techniques presently employed for individual events. Studies regarding the comparison of both starts have been investigated through kinematic and kinetics variables [1,2]. Kinematics variables are the outcome of kinetics variables, which provide information for coaches. However, the efficiency of integrated variables with kinematic and kinetics parameters, can provide further information for technique, but has not been studied. Therefore, the purpose of this study was to compare the grab start with the track start in kinematics (horizontal distance of entry) and kinetics variables (peak ground reaction force, peak vertical and horizontal force, speed strength index, i.e., SSI, impulse), and to integrate variables to estimate the starting efficiency (SSI-efficiency index, impulse-efficiency index) for both starts. The results of this study can provide coach and swimmer with different perspectives on comparative advantages of start techniques.

METHODS

Eight competitive swimmers were used in this study: four males (19.75±0.96 years of age, 170.25±5.80 cm in height, 66.35±5.32kg in body mass) and four females (20.75±2.36 years, 161.75±5.87 cm, 56.83±7.98 kg).Participants had trained at least six years with no injury. Four participants had a grab start preference, and four participants used track starts; both groups had practiced both starts for at least three months after recruitment. All subjects were required to perform two start tests in random order (three trials by each subject for each of the grab start and and the track start).

A digital video camera (JVC/9800, 60 Hz)and a Kistler force plate (1000 Hz) were used to collect motion data and kinetic variables (peak resultant ground reaction force, vertical and horizontal force, SSI, and impulse). The SSI efficiency is derived as the horizontal distance of entry divided by SSI. Impulse efficiency is derived as the horizontal distance of entry divided by the impulse. All kinetics variables were normalized by body weight, and kinematics variables were normalized by body height. The force plate was fixed above the starting platform, and the camera was setting in the sagittal plane (Figure 1). An electronic trigger with light bulb synchronized the force plate to the video camera.

Data were analyzed by t-tests with repeated measures. Measured kinetic parameters included peak ground reaction force (Fx,y), vertical and horizontal force (Fx,Fy), speed strength index (SSI), impulse, horizontal distance of entry, the SSI-effectiveness index, and the impulse-effectiveness index.

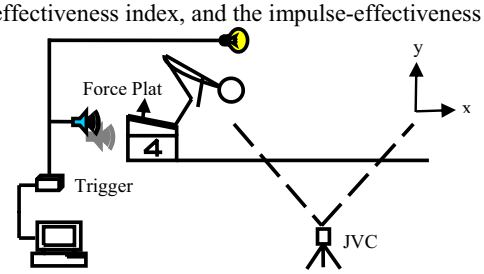

Figure 1: The diagram to show testing location.

RESULTS AND DISCUSSION

Significant differences were found between the two start types in peak ground reaction force, SSI, impulse, horizontal distance of entry and impulse- efficiency index. However, there were no significant differences between the two starts either in peak vertical and horizontal force or SSI-efficiency index (Table 1). This may derive from difference in lower limb joint flexion and in the absence of coincidence of peak force (Fx,y_{max}) of both limbs.

The impulse was a significant factor influencing flight velocity after takeoff. Impulse and horizontal distance of entry for the grab start were greater than for the track start in this study. However, the effectiveness of the track start was higher than that of the grab start (as measured by the impulse-efficiency index). The reason may due to the increased takeoff angle of track start, and then a higher flight trajectory. Such integration of kinetic and kinematics data together with derived efficiencies can provide coaches and competitive swimmers with specific technique information for swim starts.

CONCLUSIONS

The general principles of a good start are high velocity, longer horizontal distance of entry, optimal entry angle, and similar parameters. However, quantitative assessment of starts may indicate not just one aspect of greater distance performance (e.g., grab start) or of reaction force, but also a greater efficiency (as in the track start) that will provide more insight into better starting skills.

REFERENCES

1. Cosser & Mason, *Proceedings of XIX Symposium on Biomechanics in Sports,*2001.
2. Breed RVP, Mcelroy GK, *Journal of Human Movement Studies*, **39**,277-293,2000.

Table 1: Comparison of grab start and track start in kinematic and kinetic variables. (BW:body weight, BH:body height,* : p<.05)

	SSI (s^{-1}•B.W.)	Impulse (s•B.W.)	Entry Distance (B.H.)	SSI-Effectiveness Index (kg^{-1}•s2)	Impulse-Effectiveness Index (kg^{-1})
Grab start	2.16 ± 0.366	0.50 ± 0.045	1.77 ± 0.096	0.84 ± 0.121	3.57 ± 0.262
Track start	1.55 ± 0.372	0.38 ± 0.074	1.66 ± 0.115	1.24 ± 0.537	4.59 ± 0.808
P	0.002*	0.003*	0.006*	0.053	0.010*