GROUND REACTION FORCES IN SKATEBOARDING: THE OLLIE

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INTRODUCTION

Skateboarding is a popular activity that had over 11 million participants in 2006 in the US alone; a 5.2% growth over 2005 (SGMA, 2007). Skateboarding's continued growth in participation now exceeds total participation rates for tackle football and regular participation rates for baseball by more than one million participants (SGMA, 2007). Despite its popularity, little is known about even the most basic of skateboard maneuvers.

The Ollie is one of the most common movements in skateboarding. This maneuver allows the rider to hop onto, off of, and over obstacles encountered while skateboarding all without ever touching the skateboard with his hands. This basic movement is a key component of many other skateboard maneuvers.

Despite its importance to skateboarding, little is known about the biomechanics of this movement. In 2006 a study was published on the kinetics of the Ollie using professional skateboarders for test subjects (Frederick et al., 2006). They studied the movement using a single platform height of 45.7CM, a height considered relatively tall by many amateurs. Therefore, the purpose of this study was to examine the Ollie at various heights and compare how the kinetics might vary between professional and amateur skateboarders.

METHODS AND PROCEDURES

Ten male, amateur skateboarders visited the laboratory at the Sole Technology Institute to participate in this study (mean body mass = 68.8KG, SD = 8.3KG). Although amateur, all subjects far surpass the “frequent participant definition” (SGMA, 2007). Each subject performed six movements: Ollie Up Conditions 1-3 (OU1, OU2, OU3) and Ollie Down Conditions 1-3 (OD1, OD2, OD3).

The OU2 and OU3 movements required the subject to ride his board onto the force plate, mounted at floor level, and Ollie up onto a level wooden platform either 22.9CM (OU2) or 45.7CM (OU3) above floor level and either 26.7CM (OU2) or 45.7CM (OU3) beyond the end of the force plate. For the OU1 condition the wooden platform was removed and the subject was instructed to Ollie up as high as necessary to land with all four wheels completely off the force plate (landing at floor level).

The OD2 and OD3 movements required the subject to roll toward the edge of the wooden platform (located 22.86CM [OD2] or 45.72CM [OD3] above floor level) and Ollie off the platform down onto the force plate mounted at floor level. For the OD1 condition the wooden platform was removed and the subject was instructed to Ollie before the force plate, from floor level, and land on the center of the plate.

A large AMTI model BP12001200 force plate was used to measure ground reaction forces (GRFs). GRF data were collected for ten trials of each condition for each subject. The GRF data were collected at 1000Hz and low-pass filtered using a fourth-order Butterworth filter with a 50Hz cut-off frequency. All

subjects were required to wear the same model of skate shoe (Model: éS EK-01). Subjects were allowed to use their own skateboards.

RESULTS

For each OU condition the resulting Vertical Ground Reaction Force (VGRF) had a consistent two humped shape as observed in the previous study (Frederick et al., 2006). For all subjects and all OU trials the Nose/Tail Ground Reaction Force (N/T GRF) had a consistent two peak shape. The second of these N/T GRF peaks corresponds to what skateboarders refer to as the "tail-smack" phase of an Ollie. The direction of this force is toward the tail of the skateboard and thus in the lateral direction of the subject's rear foot while skating forward. This movement causes the board to rapidly rotate around the rear axel, "smack" into the ground, and then rebound into the air. Mean peak VGRFs for all subjects and trials as well as mean peak N/T GRFs for all subjects and OU trials are shown in Table 1.

Platform Height(CM)	Peak OU VGRF(BW)	Peak OD VGRF(BW)	Peak N/T GRF(BW)
0	2.13 (.20)	3.77 (.70)	.074 (.02)
22.86	2.18 (.21)	4.61 (.80)	.072 (.02)
45.72	2.14 (.22)	5.44 (.88)	.079 (.02)

Table 1. Mean Peak VGRFs and N/T Tail-Smack Forces for All Subjects and Trials Normalized to Body Weights (SD).

DISCUSSION AND CONCLUSION

Average peak VGRFs for all subjects for all OU conditions were found to be quite similar regardless of the wooden platform height. Further analysis of the GRF, motion capture, and video data collected for this study may be necessary to understand the reason(s) for this unexpected similarity.

Average peak VGRFs for all subjects for all OD conditions were higher than expected given the previous study of Ollie kinetics (Frederick et. al., 2006). In that study average peak VGRFs for professional skateboarders Ollieing down from a 45.7CM platform were found to be 4.519 ± .582BW. The authors noted that these forces were higher than expected given relatively lower VGRFs from other jump landing studies. They concluded that this was caused by the subjects intentionally "spiking" their landings in order to stabilize themselves on top of the skateboard. In our study average peak VGRFs for subjects Ollieing down from a similar height were found to be .92BW greater. Perhaps amateur skateboarders need to spike their landings even harder to stabilize themselves. It is also possible that this difference in force was due to a difference in the height the subjects Ollied off the 45.7CM platform before landing down on the force plate.

Average peak N/T tail-smack forces were unexpectedly similar in magnitude among all OU conditions and trials for all subjects. Interestingly this peak N/T GRF corresponded with a peak vertical tail-smack force. The magnitude of this force is not reported in this abstract.

REFERENCES

Frederick, E.C. et al. (2006). *J Appl Biomech*, 22:33-40.

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