Kinetic Asymmetries in Countermovement Jumps and Lateral Skaters in High School Basketball Athletes

Joseph LeSueur[1,2], Cody Dziuk[2], Maeve McDonald[1,2], Rachel L. Lenhart[2], Jessica M. Fritz[1,2]
[1]Joint Dept. Biomedical Engineering, Marquette University & the Medical College of Wisconsin, Wisconsin, USA
[2]Dept. Orthopaedic Surgery, Medical College of Wisconsin, Wisconsin, USA
Email: jlesueur@mcw.edu

Summary

Kinetic analysis of countermovement jumps (CMJ) and lateral skaters was performed in twenty-six high school basketball athletes to identify biomechanical asymmetries. Athletes demonstrated significant differences in *propulsive* forces during lateral skaters and in *landing* forces during CMJ, which may affect performance and increase risk of acute injury.

Introduction

Countermovement jumps have been utilized as a standard evaluation of neuromuscular performance and asymmetries in lower extremities of basketball players [1]. Previous studies have shown the peak rate of force development [2] and time of first force peak [3] were significantly correlated to vertical jump displacement during the CMJ, suggesting prominent influence of the concentrically contracting muscles of the lower extremity [4,5]. In movements landing on one foot, larger *medial* peak ground reaction forces (GRF) have been observed in the *non-dominant* leg [6].

Although many basketball movements include rapid propulsion off one leg in the lateral direction, limited studies have performed biomechanical evaluation of this motion. However, recent studies have evaluated this motion in speed skaters, in which bilateral asymmetries of knee kinematics and push-off speed have been observed [7].

Therefore, the purpose of this study was to evaluate inter-limb asymmetries in CMJ and lateral skaters in high school basketball players. This biomechanical assessment may be used to identify potential imbalances in strength, eccentric control, and explosiveness, which may be addressed to enhance performance and prevent musculoskeletal injuries.

Methods

Twenty-six male high school basketball athletes participated in this study. Each participant performed three CMJs with no arm swing (CMJ NAS), three CMJs with arm swing (CMJ AS), and three lateral skater movements off each foot. Kinetic data was captured using portable force plates (Bertec Co., Columbus, OH). Temporal metrics, jump height, and peaks of loading and unloading vertical ground reaction forces were analyzed (Hawkin Dynamics, Westbrook, ME). Force metrics were normalized by body mass and three trials of each movement were averaged. Paired t-tests were conducted for each metric to compare inter-limb asymmetries.

Results and Discussion

Athletes demonstrated significantly greater normalized propulsion force with the left foot compared to the right foot during lateral skaters ($p<0.001$). Normalized peak *propulsion* forces were similar between the left and right foot in CMJ NAS and CMJ AS. However, normalized peak *landing* forces were significantly greater on the right foot compared to the left foot in CMJ NAS ($p=0.02$) and CMJ AS ($p=0.007$) (**Figure 1**). Jump height was significantly greater in CMJ AS than CMJ NAS ($p<0.001$), but peak propulsion between CMJ AS and CMJ NAS was not significantly different.

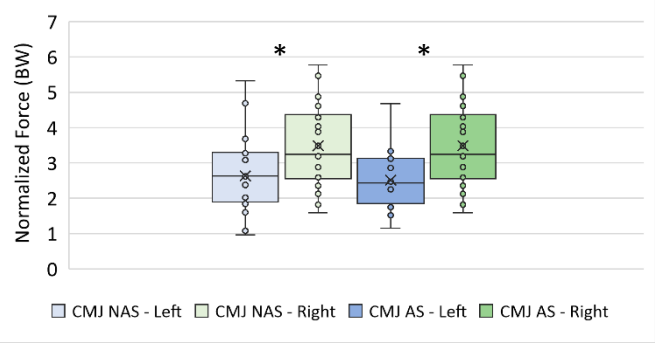

Figure 1: Mean normalized peak force during *landing* between left (blue) and right (green) feet in CMJ NAS and CMJ AS (*$p<0.05$).

Greater propulsion forces off the left foot may be due to preference and predominant repetition of right-handed layups, which utilize propulsion off the left foot. Twenty-one of the 26 athletes had greater propulsive force on the left side during lateral skaters. These athletes may benefit from contralateral explosive training and more practice with left-handed layups. Significant differences between sides in normalized forces during landing may be due to asymmetrical activation or imbalances of eccentric muscle contractions of the lower limbs. Further studies may investigate the correlation between injuries and asymmetry in landing kinetics during various sport-specific tasks, which may provide insight into identifying athletes' susceptibility to injury.

Conclusions

Asymmetries were present in *propulsive* forces during lateral skaters and in *landing* forces during CMJ NAS and CMJ AS. These imbalances may increase the risk of acute injury.

Acknowledgments

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