C1 Canoe Slalom Upper Body Muscle Activity during On- and Off-side Strokes

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Summary

This study compares muscle activation during on-side and off-side strokes in slalom C1 canoeing. Surface electromyography was recorded bilaterally from the biceps, triceps, latissimus dorsi, and erector spinae muscles during a C1-specific test for three C1 athletes. Results showed significant differences in muscle activation between stroke types, particularly in the biceps and triceps. On-side strokes involve torso rotation, contributing to propulsion, while off-side strokes rely more on arm strength, suggesting that athletes with stronger arms may perform more powerful off-side strokes. These results highlight the importance of arm strength for off-side strokes in slalom canoeing, with muscular strength potentially influencing stroke selection.

Introduction

Canoe slalom is a white-water sport involving a single bladed paddle. The paddle must be used on both sides of the boat, creating two stroke types: on-side and off-side strokes (Figure 1). Previous studies have examined the muscle use of sprint C1 paddlers [1] and slalom kayakers [2], but neither of these types of paddling use off-side strokes. The purpose of this study was to compare the use of upper body and arm muscles during on-side and off-side strokes in slalom C1 canoeing.

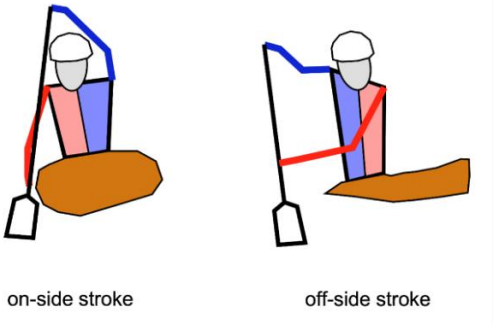

Figure 1: On-side (left) and off-side (right) paddle strokes. The top arm is shown in blue, while the bottom arm is shown in red.

Methods

Surface electromyography (EMG) was recorded bilaterally from the biceps (BI), triceps (TRI), latissimus dorsi (LAT), and erector spinae (ES) muscles during an C1-specific ergometer test for two C1 athletes and bilaterally from the BI and TRI of one athlete on a flatwater figure-of-eight course. The normalized pull-phase Root-Mean-Square (RMS) EMG was calculated and used for statistical analysis.

Results and Discussion

Data were analyzed for 498 on-side strokes and 293 off-side strokes. There was a significant athlete effect for the EMG from all muscles tested. A significant main effect of stroke-type on the EMG was detected for the BI, TRI and LAT (Figure 2).

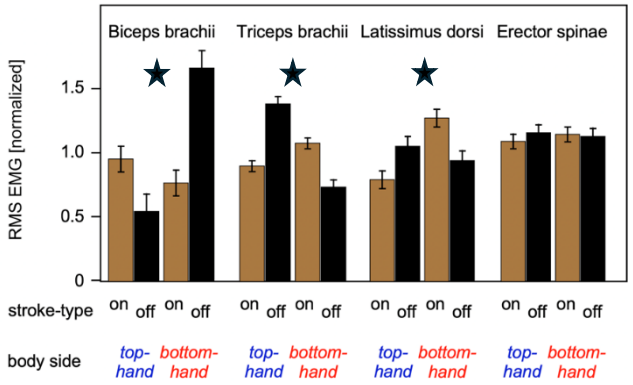

Figure 2: Estimated marginal means (with standard error of mean) of the normalized RMS EMG. On-side paddle strokes are in brown, and off-side strokes are in black. Significant main effects of stroke-type shown by asterisks.

During on-side strokes, torso rotation contributes to propulsion, however, for off-side strokes this plays a less prominent role. Instead, C1 athletes rely more on their arm strength for off-side strokes, which can be seen by the increased activity of top-hand TRI and bottom-hand BI during the power phase of the off-side strokes (Figure 2).

Not only is upper body strength important for success in canoe slalom in general [3] but it appears critical for off-side C1 paddle strokes. Thus, if muscular strength limits performance, then we would infer that athletes with reduced biceps strength would be less able to perform strong and powerful off-side strokes, thus choosing to switch their hand position to perform an on-side stroke instead.

Conclusions

Although athletes rotate their torso to propel the canoe forward during on-side strokes, arm strength is highly important for off-side strokes, suggesting that arm strength may contribute to differences in the selection of strokes by different athletes.

Acknowledgments

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References

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