

The effect of breathing on hip roll asymmetry in competitive front crawl swimming



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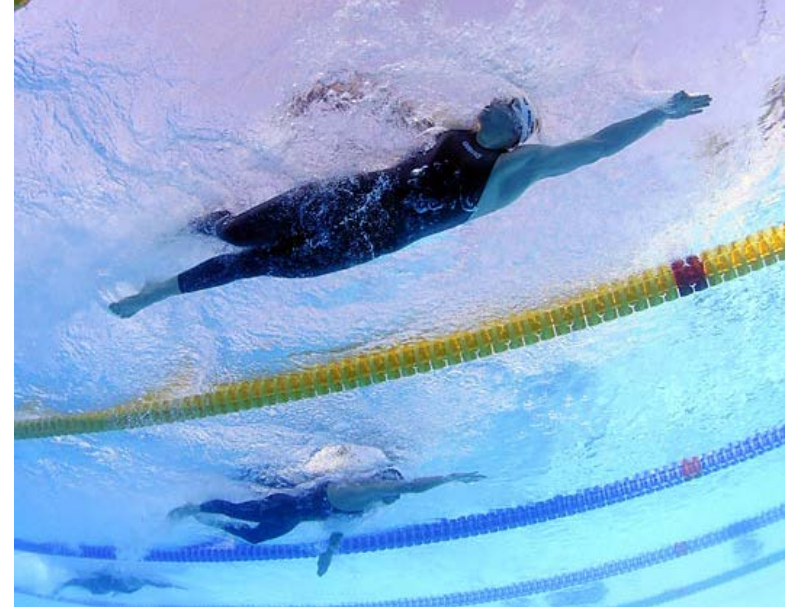
University of Regina



Introduction

Background:

- Body Roll – the rotation of the trunk about the longitudinal axis
- Body roll quantified separately as hip and shoulder roll.
 - Shoulder roll > hip roll (Psycharakis & Sanders, 2008)
- As velocity increases, hip and shoulder roll decreases (Castro et al., 2006)
- Hip and shoulder roll increases when breathing (Psycharakis & McCabe, 2011)
 - No comparison of all breathing conditions exists



Introduction

Quantifying Body Roll:

- Underwater environment is unique and challenging
- **2D Video Analysis:** Balsa wood fin (Payton et al., 1999)
- **3D Video Analysis:** (Psycharakis & Sanders, 2008)
 - Limited recording zone (1-2 strokes per length)
 - Time consuming digitizing of data
 - Cost/lack of facilities with proper equipment
- **Accelerometer:** (Bachlin & Troster, 2012)
 - Non-invasive, allows for continuous measurement, multiple strokes/length
 - Data as good as or better than video (Davey, Anderson & James 2008)



Introduction

Purpose:

1. To investigate the effect of breathing side on hip roll in competitive front crawl swimming. Specifically, how does hip roll differ between the following conditions:
 - a) Unilateral preferred side breathing
 - b) Unilateral non-preferred side breathing
 - c) Bilateral breathing
2. To investigate the effect of breathing side on hip roll asymmetry

Hypotheses:

- Hip roll angle will be greater when breathing
- Hip roll angle will be symmetric for the bilateral condition
- Hip roll angle will be asymmetric for the two unilateral breathing conditions and it will be greater on the preferred side

Methods

Participants:

- 20 National/Provincial level competitive swimmers (13 male, 7 female)
- Min. provincial “A” standard in a front crawl event in previous 12 months

Protocol:

- 3 x 100 m front crawl repetitions @ 70% of season best time (100m free)
- 2 min. recovery period between repetitions
- Randomized breathing condition:
 - unilateral preferred
 - unilateral non-preferred
 - bilateral

Methods

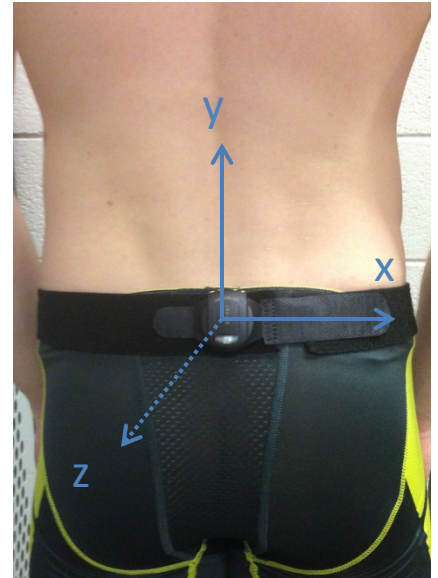
Data Collection & Analysis:

- Tri-axial accelerometer (GENEActiv, UK) attached at L5/S1
- Sampled at 100 Hz, low-pass filter with 4 Hz cutoff

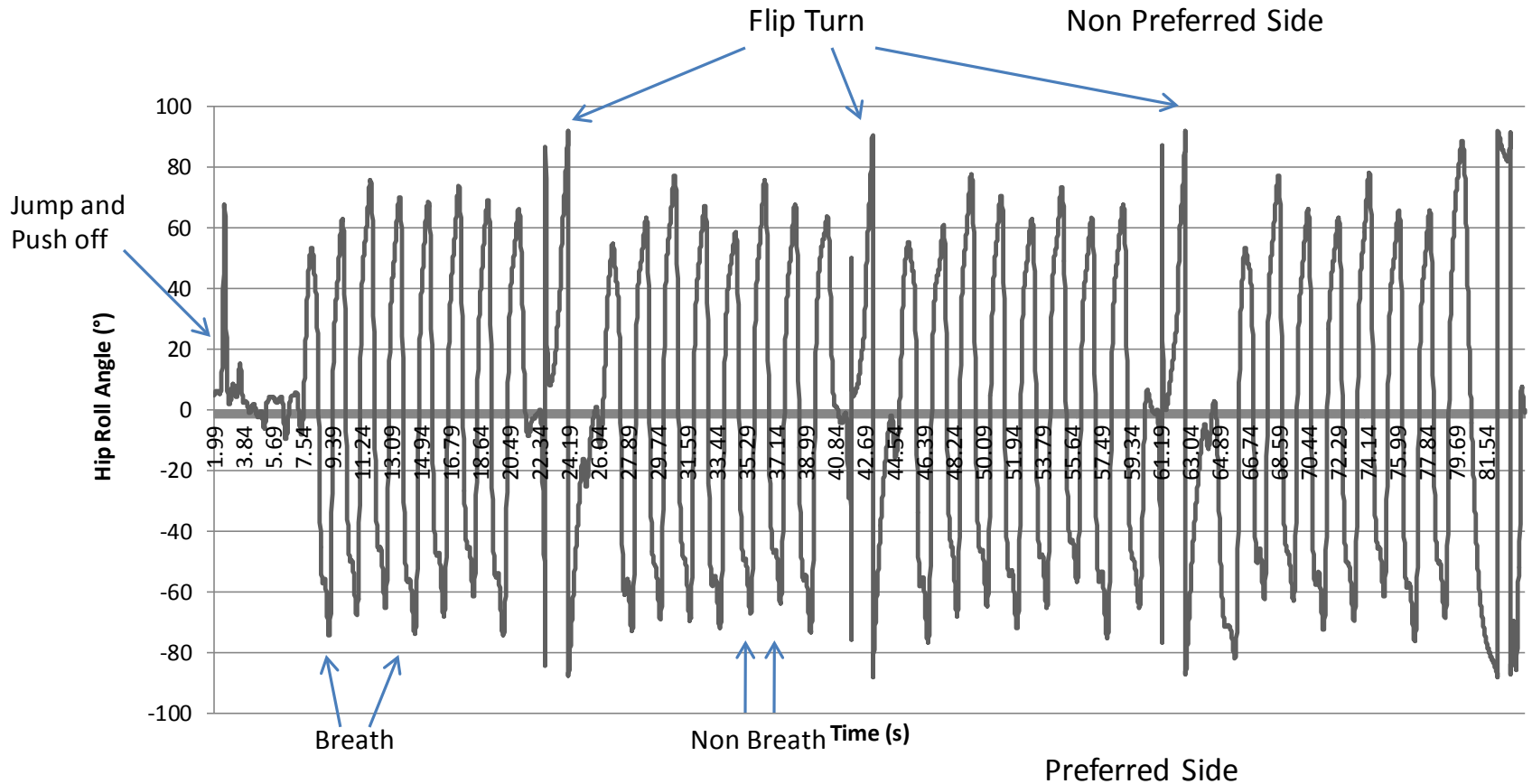
- Hip roll angle(°) = $\arctan(x/z)$

- ASI% =
$$\left(\frac{2 * (P - NP)}{(P + NP)} \right) * 100$$

- RM ANOVA ($p < 0.05$) to look at effects of;
 - Time and length
 - Condition, breath & side
- Post Hoc analysis of main effects
- Dependent variables were peak roll angle, total roll angle, asymmetry index (ASI)



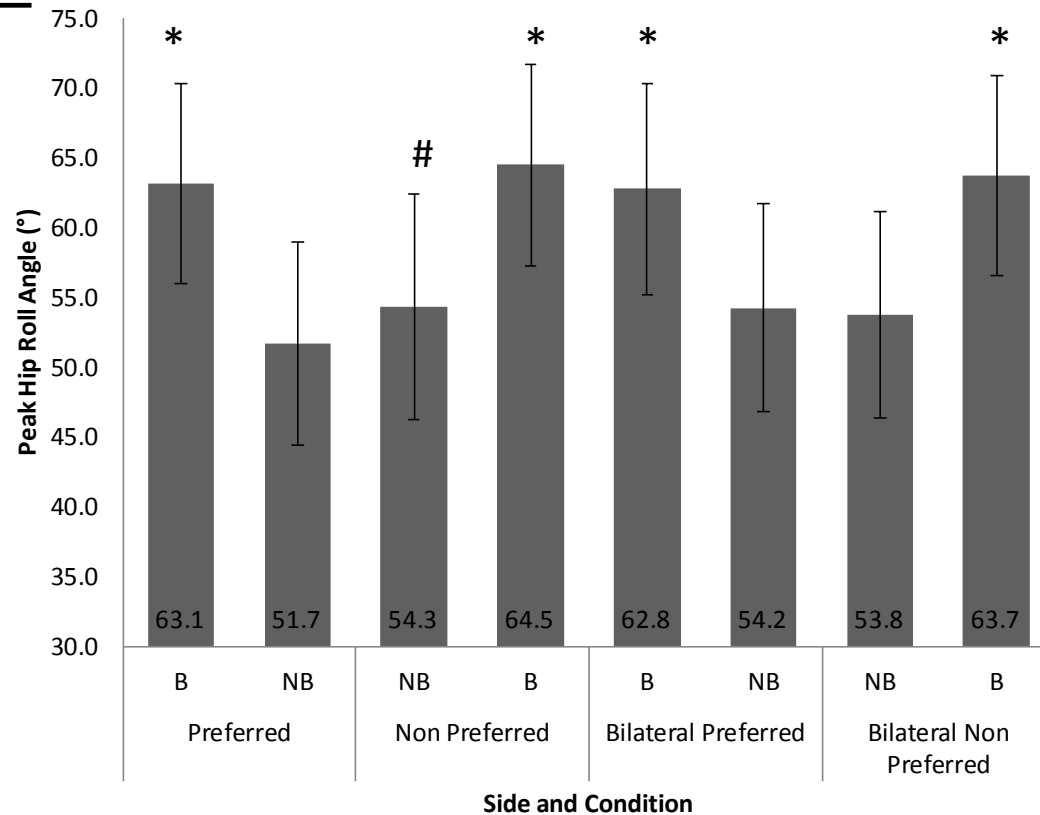
Results



A representative filtered accelerometer signal from one bilateral trial

Results

Peak Hip Roll Angle:

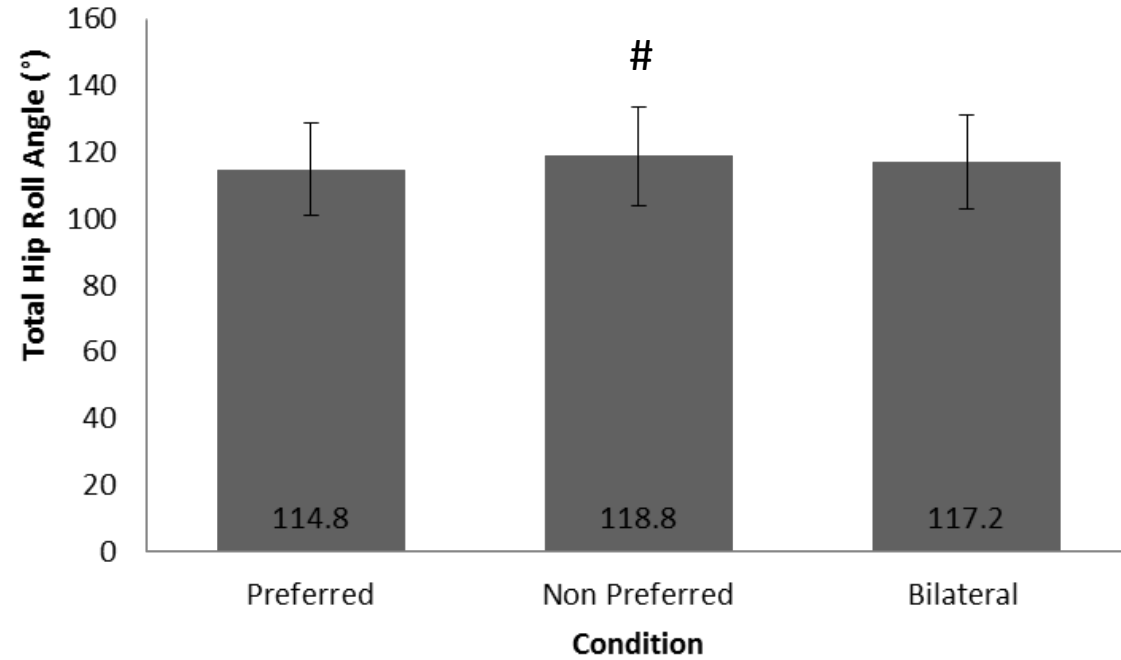


*Significantly greater ($p < .05$) than non-breathing side

^ Significantly greater ($p < .05$) than non-breath in preferred condition

Results

Total Hip Roll Angle:

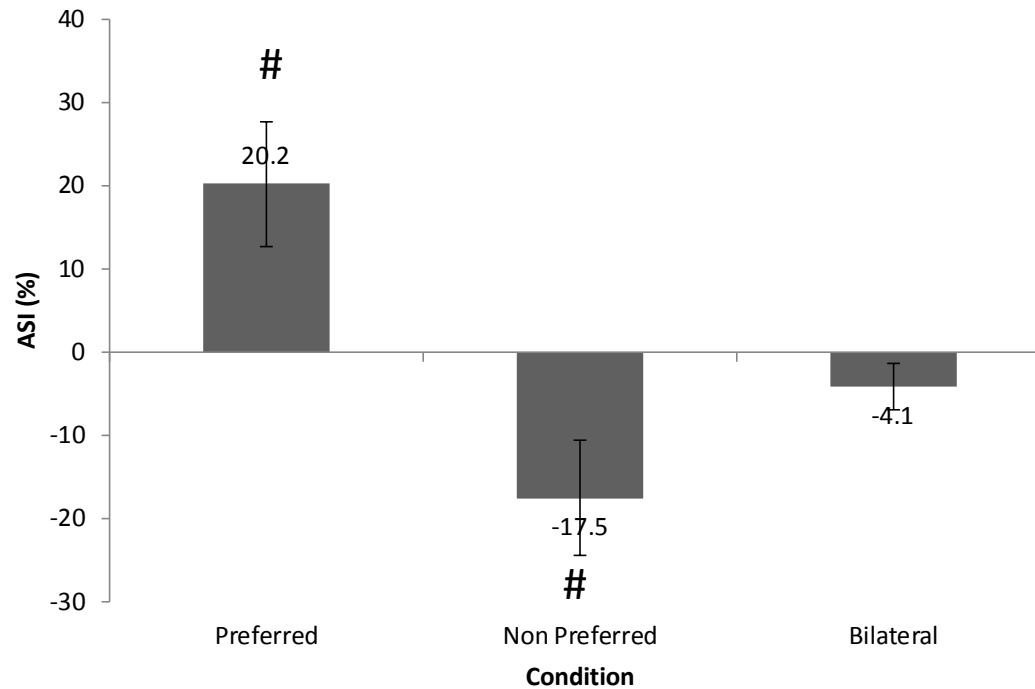


significantly greater ($p < .01$) than the preferred condition

Note: Negative ASI value indicates asymmetry to non-preferred side

Results

ASI:



significantly greater ($p < .01$) than the bilateral condition

Note: Negative ASI value indicates asymmetry to non-preferred side

Discussion

- Peak hip roll angle was significantly greater to the breathing side than non breathing side in each condition
- Values greater than previous 3D video studies (Psycharakis & Sanders, 2008; Psycharakis & McCabe, 2011). However, similar to previous study using an accelerometer (Bachlin & Troster, 2012)
 - Previous studies used maximal effort and faster velocities
 - Current study provides ~8 stroke cycles per length vs. 1 per length in previous studies (Psycharakis & Sanders, 2008; Psycharakis & McCabe, 2011)
 - Sensor placement may account for some of the increased roll angle
 - Anatomically superior to hip position in 3D video studies
- Significant difference in peak non-breathing angle in the unilateral conditions
 - Suggests other mechanisms (e.g., motor laterality) influence hip roll asymmetry

Discussion & Conclusion

- ASI is greatest when breathing unilaterally
 - Bilateral breathing reduces asymmetry
 - Implication for training?
- Hip roll asymmetry exists
 - It is both breathing and side (preferred vs. non-preferred) dependent
- Hip roll asymmetry is a likely contributor to stroke asymmetry
 - Other possible factors include; strength, range of motion, propulsive force, technique, dominance

Thank You



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