COLLEGE OF EDUCATION
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

**Research Horizons day & Research Week March 11-15, 2019**

Research Horizons Day

# The Effect of Shin-Torso Alignment and Biomechanical Positioning on Muscle Activity of the Lower Extremity in Ice Hockey Players

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## Introduction

- Ice Hockey has many prevalent overuse injuries that commonly occur throughout a season, the most common being knee medial collateral ligament sprains and ankle sprains
- One of the most important risk factors for these overuse injuries is improper biomechanical form. Anecdotally, arguments have been made that aligning the angle of the torso to be parallel with the shin is optimal for performance and injury prevention
  - In this aligned position (STA), there should be an equal distribution of musculature contraction on the anterior and posterior aspects of the thigh.
- The purpose of this study was to see how three different skating positions (forward lean = FL, STA, and upright = UR) affect muscular activation in the lower body
- It was hypothesized there would be more balanced muscle activity in the lower extremity during the STA simulated skating stride compared to the FL and UR positions
- In the UR position, it was expected that the anterior musculature would be more activated while the FL position would elicit more activation from the posterior musculature

## Methods

### STUDY DESIGN & SUBJECTS

- Cross-sectional study design was utilized with nineteen male hockey players (21.63 ± 1.3 years, 177.53 ± 6.03 cm, and 80.82 ± 5.32 kg)

### PROCEDURES

- Participants were assessed in three different simulated skating positions (FL, STA, and UR; Figure 1)
- Trials were 45 seconds on a slide board.
- Order of positioning was randomized, and the middle 15 seconds of each trial was analysed for each subject.
- Surface electromyography (EMG) was captured using wireless sensors (Biometrics Ltd; Figure 2) to measure muscle activation of the lower body musculature:
  - Rectus femoris (RF), vastus medialis (VM), vastus lateralis (VL), semitendinosus (ST), biceps femoris (BF), gluteus maximus (GM), erector spinae longissimus (ESL), and erector spinae iliacus (ESI).

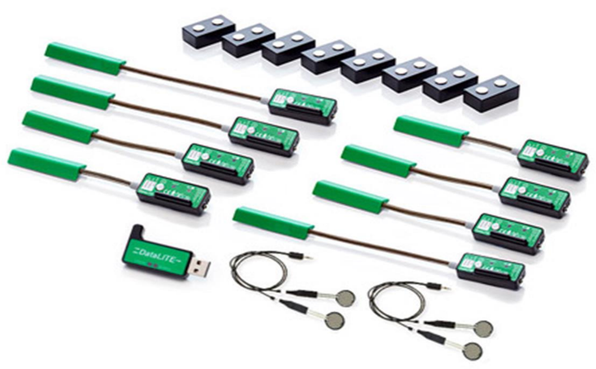

**Figure 2.** Biometric Ltd Equipment

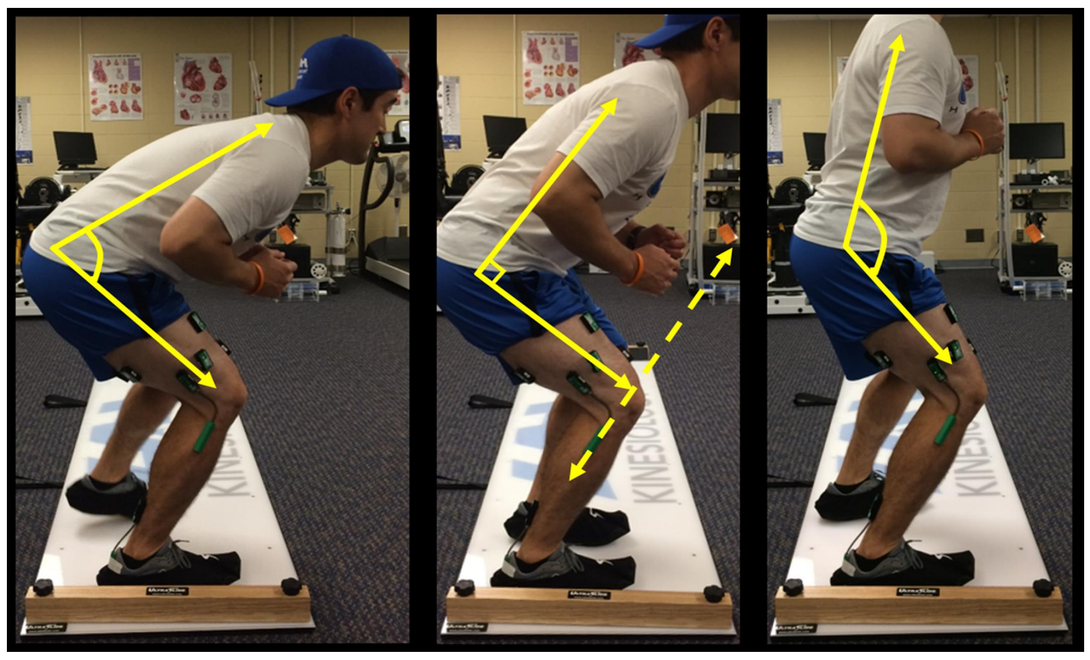

**Figure 1.** Three Positions : (left to right) Forward Lean, Shin-torso Alignment, Upright

### STATISTICAL ANALYSIS

- Normality was assessed with the Shapiro Wilk test.
- Repeated measures one-way ANOVA's were utilized to analyze the data for normally distributed values: Mean ± S.D. reported and $\eta^2$ for effect sizes.
- Friedman ANOVA was used for non-normally distributed values: medians reported and $\bar{r}$ for effect size.
- All Variables analysed by SPSS (v23, SPSS Inc. )

## Results

- Significant differences ($p \leq 0.029$) were found for muscle activation in the posterior musculature: GM and ST (FL > STA > UR).
- A significant difference ($p < 0.035$) was also found for the VL (UR > STA)
- Large effect sizes were found for the VL ($\eta 2 = 0.214$).
- Medium effect sizes were found for the RF ($\eta 2 = 0.061$), the across all positions.
- Significant differences were present for joint angles across trials.

## Conclusion

- This knowledge can help hockey coaches prevent overuse injuries throughout a season by adjusting biomechanical positioning and skating technique. By achieving equal distribution of muscle activation in the anterior and posterior musculature of the lower extremity there could be a lower chance of fatigue and injury throughout the season.

| | FL | | STA | | UR | | *p*-value | Effect Size | Group Comparison |
|---|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | Median | Mean ± SD | Median | Mean ± SD | Median | | | |
| GM* | 0.658 ± 0.428 | 0.504 | 0.592 ± 0.393 | 0.412 | 0.550 ± 0.392 | 0.482 | 0.012 | 0.193 | FL>STA>UR |
| BF* | 1.465 ± 1.837 | 0.561 | 0.899 ± 1.542 | 0.424 | 0.866 ± 1.411 | 0.375 | 0.074 | 0.129 | |
| ST* | 0.571 ± 0.337 | 0.489 | 0.558 ± 0.325 | 0.466 | 0.487 ± 0.322 | 0.411 | 0.029 | 0.143 | FL>STA>UR |
| RF | 0.895 ± 0.330 | 0.866 | 1.082 ± 0.647 | 0.952 | 0.992 ± 0.445 | 0.903 | 0.365 | 0.061 | |
| VM* | 1.439 ± 0.776 | 1.206 | 1.325 ± 0.511 | 1.204 | 1.509 ± 0.753 | 1.356 | 0.607 | 0.015 | |
| VL | 1.297 ± 0.515 | 1.190 | 1.385 ± 0.775 | 1.172 | 1.506 ± 0.963 | 1.301 | 0.035 | 0.214 | UR>STA |
| ESL* | 0.540 ± 0.349 | 0.417 | 0.530 ± 0.236 | 0.519 | 0.528 ± 0.283 | 0.445 | 0.331 | 0.008 | |
| ESI* | 0.800 ± 0.634 | 0.626 | 0.600 ± 0.321 | 0.452 | 0.745 ± 0.452 | 0.633 | 0.465 | 0.005 | |

**Table 1**. Average values of muscle activation: Mean ± SD, Median, Effect Sizes, *P* Value and Significance. Effect Size for Repeated Measures ANOVA ($\eta^2$): 0.01 = S 0.06 = M 0.14 = L. Effect Size for Friedman's ANOVA ($\bar{r}$): 0.1=S 0.3=M 0.5=L*

## References

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## Acknowledgements

Special thanks to Dave Cook, Dr. Vogler of the RCEU Staff and to the Alabama Space Grant Consortium, Office of Provost, President, and VP for Research and Economic Development for sponsorship of this project