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# 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 to the angle of the shin is optimal from a performance and injury prevention standpoint. In this properly aligned position, there should be 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, neutral, and upright) effect muscular activation in the lower body. It is hypothesized that there will be more balanced muscle activity in the lower extremity during a simulated skating stride when proper shin-torso alignment is used compared to forward lean and upright skating positions. In the upright position, it is expected that the anterior musculature will be more activated and in the forward lean position, the posterior musculature will be more activated. Research also shows that increased lower back musculature activation increases the likelihood of lower back pain. If identified, hockey players will be able to adapt their technique in order to have a more balanced distribution of muscular activity and ideally reduce fatigue in any one given muscle.

## Methods

Six male hockey players (24.0 ± 4.5 years, 179.3 ± 6.9 cm, and 80.2 ± 7.9 kg) were assessed in three different skating positions (Forward Lean, Shin Torso Alignment, and Upright; Figure 1) on a slide board for 45 second trials. Order of positioning was randomized, and the middle 15 seconds of each trial were analysed for each subject. Surface Electromyography (EMG) sensors were placed on the rectus femoris (RF), vastus medialis (VM), vastus lateralis (VL), semitendonosus (ST), biceps femoris (BF), gluteus maximus (GM), erector spinae longissimus (ESL), and erector spinae iliacus (ESI). These sensors measure muscle activation.

### Statistical Analyses

- Normality was assessed with Shapiro Wilk Test
- Repeated measures one-way ANOVA utilized to analyze the data for normally distributed values: mean ± SD reported and $\eta^2$ for effect sizes.
- Friedman ANOVA was used for non-normally distributed values: medians reported and $\bar{r}$ for effect size.

### References


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2. Chui, ren Z. (2009). Sitting Back in the Squat : Strength & Conditioning Journal. *And Conditioning Journal*, *31*(6), 25–27.


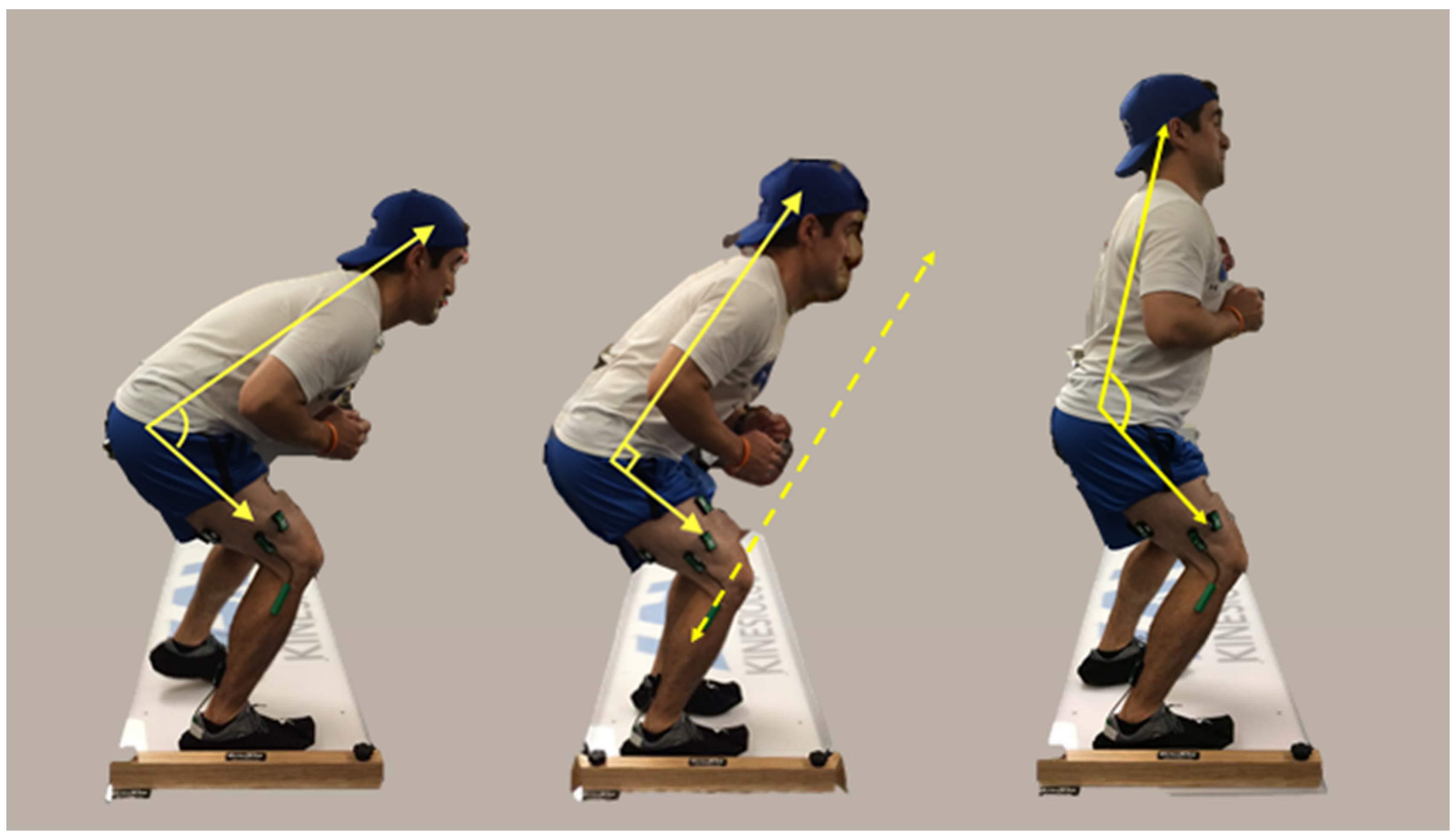

Figure 1. Three Positions : (left to right) Forward Lean, Shin-torso Alignment, Upright

## Results

- No significant differences for any muscle (*p ≥ .063)*
- BF, ST, and VL showed large effect sizes which indicates that altering the position does have an effect on muscle activation patterns ($\eta^2 \geq .174$); GM and VL showed a medium effect size ($\bar{r} \geq .100$).
- The BF, ST, and GM all showed higher activation in the forward lean than the upright positions which fit the hypothesis.
- The ESL and ESI showed higher activation in the upright position.

Table 1. Average values of muscle activation: Mean ± SD, Median and Effect Sizes
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*

| Sensor | Forward Lean (Mean ± SD, Median) | | Shin Torso Alignment (Mean ± SD, Median) | | Upright (Mean ± SD, Median) | | Effect Size |
|---|---|---|---|---|---|---|---|
| GM* | .634 ± .306 | .589 | .550 ± .303 | .393 | .458 ± .175 | .448 | .333 (M) |
| BF | .369 ± .109 | .359 | .288 ± .087 | .262 | .274 ± .067 | .283 | .424 (L) |
| ST | .454 ± .227 | .394 | .476 ± .105 | .505 | .378 ± .155 | .382 | .174 (L) |
| RF* | .818 ± .367 | .713 | .755 ± .259 | .775 | .789 ± .391 | .657 | -.166 |
| VM* | 1.163 ±.304 | 1.112 | 1.272 ±.369 | 1.187 | 1.281 ±.443 | 1.064 | .100 (M) |
| VL | 1.016 ± .290 | 1.106 | .902 ± .321 | .992 | 1.004 ± .432 | 1.091 | .192 (L) |
| ESL* | .402 ± .080 | .396 | .456 ± .099 | .479 | .543 ± .416 | .413 | -.166 |
| ESI | .515 ± .218 | .496 | .518 ± .254 | .428 | .544 ±.231 | .555 | .025 |

## Conclusion

This knowledge can help hockey coaches and strength 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 will be a lower chance of fatigue and injury throughout the season.

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