

# THE EFFECTS OF FATIGUE ON SKATING MECHANICS IN ICE HOCKEY

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## INTRODUCTION

Ice hockey is a fast paced sport requiring the ability to perform lower intensity striding and gliding, interspersed with bursts of high intensity skating. From a biomechanical perspective, an efficient and powerful skating technique can also contribute to fast skating. Page (1975) and Marino (1979) have conducted kinematic analyses of lower body mechanics that contribute to fast skating [1,2]. The purpose of this study was to investigate the effects of fatigue on skating mechanics in female ice hockey players.

## METHODS

Three female varsity hockey players volunteered in the study. Subjects were fitted with reflective joint markers on the right and left sides of the body at the hip, knee, ankle, heel, and 5<sup>th</sup> toe. Subjects wore skates and gloves, and carried a hockey stick. Subjects skated from goal line to goal line, stopped, and returned to the blue line nearest the starting point. A short period of rest was given between repetitions. Each subject performed a total of 3 repetitions, which were timed using a hand held stopwatch.

Video data were collected using 2-D videography on a high-speed JVC GR-DVL 9800 digital video camera operated at 60 Hz. The camera was placed perpendicular to the skating direction to capture the sagittal view of the subjects. Each repetition consisted of 2 trials that the subject skated through the camera view. A distance of 7.02 m between the red line and blue line was captured for each trial. A total of 6 trials (3 odd trials from the right side and 3 even trials from the left side) for each subject were collected. Video were analyzed using the APAS<sup>TM</sup> (Ariel Performance Analysis System). The absolute trunk angle, relative knee angle, and relative shank angle were determined for each trial. The statistical analysis was a one-factor repeated measures ANOVA at  $\alpha = 0.05$  for all trials followed by pairwise t-test comparisons with Bonferroni adjustment. A dependent sample t-test was conducted between odd numbered trials and even numbered trials at  $\alpha = 0.05$ . SPSS software was used for all the statistical analyses.

## RESULTS AND DISCUSSION

The mean absolute trunk angle did not significantly decrease between the odd numbered trials (non-fatigued) and even numbered trials (fatigued). However, there was a decrease in trunk angle from each odd numbered trial and its following even numbered trial. This difference was not

significant. The relative knee angle at touchdown did not show any significant difference between all trials and between odd numbered trials and even numbered trials. The relative shank angle increased significantly from the first trial to the last trial as well as from the odd numbered trials to the even numbered trials (Table 1).

Even though the knee angle was not significant between odd numbered trials and even numbered trials, it did show an increase of knee extension movement. The increased angle at the knee and ankle indicate decreasing knee flexion in varying states of fatigue. The results of the experiment suggested that as a player became fatigued, they would tend to have a more upright stance. Research studies have found that fatigue in hockey leads to a decreased ability to generate force in the lower limbs for propulsion [3,4]. A player that had been skating for a longer period of time was not able to achieve the same deep knee and ankle positions that would generate powerful propulsion and a high rate of striding that translates into faster skating.

## CONCLUSIONS

Based on the results of this study, it was concluded that fatigue in ice hockey leads to biomechanical responses that could translate into decreased on ice performance. Deep knee and ankle bend are important in generating forceful strides and fast skating as well as contributing to most other skills executed in hockey. The results of this study indicated the importance of limiting shift lengths in games. It is also important to consider the effects of over-skating younger athletes in practice, as conditions of fatigue may hinder proper skill development.

## REFERENCES

1. Marino GW. *The Research Quarterly* **4(1)**, 893-97, 1979.
2. Page P. Unpublished Masters Thesis, Dalhousie University, 1975.
3. Marino GW, et al. *Proceedings of the VII International Symposium on Biomechanics in Sports*, 269-275, 1989.
4. Marino GW, et al. *Proceedings of VIII International Symposium of the Society of Biomechanics in Sports*. Prague, Czechoslovakia, 107-111, 1990.

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**Table 1:** Kinematics of lower limb angles.

Trials	Trunk (deg)	Knee (deg)	Shank (deg)
Odd	38.0 ± 3.2	110.3 ± 5.4	66.7 ± 6.4
Even	33.8 ± 2.8	116.7 ± 2.5	75.0 ± 6.6
p-value	0.10	0.07	*0.00

\* Significant  $p < 0.05$