

Head Impact Biomechanics by Ice Zone and Athlete Role in Youth Ice Hockey

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Introduction

There are nearly 1 million ice hockey athletes under the age of 20 worldwide [1]. Hockey has a high concussion rate, and athletes are frequently exposed to subconcussive impacts, which do not result in clinical injury. However, these impacts are of rising concern due to their association with neurocognitive and microstructural brain changes [2-4]. Prior hockey research has demonstrated that apparent anticipation of contact affects head kinematics, while player position does not [5,6]. Location on the ice (i.e., ice zone) may be a better discriminator of exposure than player position. Athlete role during checking, a common source of player-to-player contact, may be of interest as well. Therefore, the objective of this study was to evaluate the effect of ice zone and athlete role on peak head kinematics in youth hockey.

Methodology

This study enrolled male athletes (n=18, ages 12-14) from a local 14U hockey team. Athletes were fit with an instrumented mouthpiece featuring a tri-axial accelerometer and gyroscope embedded within a rigid retainer bonded to an elastomer overlay described previously [7]. Briefly, mouthpiece data were filtered, zero-offset, rotated, and transformed to the subjectspecific head center of gravity.

Impact data were collected during 127 sessions across 2 seasons. Mouthpiece data was paired with time-synchronized video to identify contact scenarios. Two types of contact scenarios, board checks and mid-ice collisions were coded for athlete role (impact target, impact initiator, or incidental contact) and zone (ice location during collisions; neutral, offensive, and defensive zones). Resultant time histories and summary statistics of peak resultant kinematics were calculated and compared by zone and athlete role.

Results and Discussion

585 body checks were identified for analysis from 892 video-verified mouthpiece events. Most body checks occurred in games (n=533, 91%) compared to practices (n=52, 8.9%). There was little variation in median and 95th percentile peak head kinematics across zones; however, among mouthpiece-recorded impacts, impacts occurred in offensive and defensive zones approximately twice as often as in the neutral zone. This is could be because more active gameplay occurs in defensive and offensive zones compared to the neutral zone.

Intentional body checks (target and initiator contacts) had higher median peak kinematics than incidental contacts, but 95th percentile accelerations were higher for incidental contact. Consistent with previous findings, incidental contacts occurred when athletes appeared less aware of their surroundings [5]. In this sample, instrumented athletes were collision targets 1.77 times more often than initiators. However, not all contacts observed on video were recorded by the mouthpiece. Additional review of all contact may provide additional insight on athlete role and frequency.

This study aimed to compare head kinematics to ice zone and athlete role, adding to a limited body of knowledge on determinants of head impact exposure in hockey. We found little variation in kinematics by ice zone. Intentional contacts had higher peak kinematics than incidental contact, and occurred more frequently. Results of this study may be used to drive future sport specific interventions and regulations, reducing head impact exposure and improving safety.