 

# QUANTIFYING HEAD IMPACT EXPOSURE, MECHANISMS AND KINEMATICS USING INSTRUMENTED MOUTHGUARDS IN MALE HIGH SCHOOL LACROSSE

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## ABSTRACT

The male version of lacrosse is a helmeted collision sport, which allows stick checking and body contact. Although changes to checking rules have attempted to reduce the incidence of concussion in male lacrosse, head impacts can occur when stick checking and body contacts are being executed. Few studies have used rigorous video analysis to verify sensor recorded events in male lacrosse. A male high school varsity lacrosse team of 25 players wore the Stanford Instrumented Mouthguard (MiG) during 12 competitive games. Video footage was reviewed to remove false-positive recordings and verify head impacts, which resulted in 13 head impacts over 69 athlete-exposures (0.19 head impacts per athlete-exposure). Of the 13 video-confirmed head impacts, 7 impact events were stick-to-head (53.8%), 3 were body-to-head (23.1%), 1 was head-to-head (7.7%) and the remaining 2 events were indirect impacts involving body-to-body contact with no observable head contact (15.4%). The most common impact site was the front of the head (5, 38.5%), followed by the side (3, 23.1%) and rear (3, 23.1%). The median peak linear acceleration, angular velocity and angular acceleration values of the 13 video-verified impacts were 36.1 g, 13.7 rad/s and 3596 rad/s$^2$, respectively. Future work should be directed towards the collection of a larger sample size of impacts in male lacrosse to confirm the estimates of head impact biomechanics reported in the current study. In addition, substitutions should be temporally tracked so that impact rate can be calculated per player-hour for more accurate comparisons across sports and gender.

**Keywords:** biomechanics, head impact sensor, injury prevention, lacrosse

## INTRODUCTION

Originally played by Native Americans in the 17th century [1], the modern game of lacrosse is colloquially known as the 'fastest game on two feet' due to the speed at which the ball can be moved down the field [2]. Lacrosse is played at the youth, high school, collegiate and professional levels by males and females. The male version of lacrosse is a helmeted collision sport, which allows stick checking and body contact [3]. Although changes to checking rules have attempted to reduce the incidence of concussion in male lacrosse [4], head impacts can occur when stick checking and body contacts are being executed. In order to inform policy discussions and rule changes for improved protection, it is important to accurately quantify exposure, mechanisms and biomechanics of head impacts in male lacrosse.