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Changes in the Impact Attenuation Performance of Field-Used Hockey Helmets Over Time

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ABSTRACT

Hockey helmets have expiry dates or recommended replacement intervals. There are several certification organizations that recommend or mandate replacement of hockey helmets at regular intervals regardless of damage.

Despite recommendations, helmets are often used past their intended lifespan. There is limited data on the changes in impact attenuation of ice hockey helmets over time [1,2] and no data on the changes in impact attenuation of field-used hockey helmets over time. Given the high frequency of head impacts and head injuries in ice hockey [3,4], more data is needed to improve the quality and longevity of players' head protection. The objective of this study is to evaluate the changes in impact attenuation over time for a sample of field-used hockey helmets.

A sample of approximately 750 field-used hockey helmets has been collected, with a goal of 1000. The age, energy absorbing materials, and any damage or degradation was identified and catalogued.

All helmets will be subjected to three repeated, ambient temperature, 4.5m/s impact tests at the rear of the helmet, on a moving headform monorail in accordance with the ASTM F1045-16 and CSA Z262.1-15 standards for hockey helmets. The outcome variable is peak linear headform acceleration. Acceleration was measured using an Endevco 7264B-2000 accelerometer, sampled at 20,000 Hz with a CFC 1000 low-pass filter.

Impact data at the rear location has been collected from 280 helmets with ages ranging from 3 to 25 years. Average peak acceleration was 123.3 g (sd=16.9). Preliminary analysis of all peak acceleration versus helmet age data shows no age effect using linear regression ($p=0.9$). This was also observed when helmets were stratified by headform size. Helmets constructed with vinyl nitrile impact absorbing material ($n=128$) showed a marginally significant age effect of 0.6 g/year ($p=0.06$). No age effect was observed for helmets constructed with expanded polypropylene ($n=81$, $p=0.8$). Future analysis will incorporate more sophisticated statistical methods to control for make/model, wear, material, size, etc.

After all helmets are tested, a subset of the population grouped by similar make/model will be subjected to additional 4.5m/s impact series at additional impact sites. This series will evaluate age effects on impacts associated with serious injuries.

This study will evaluate whether the impact attenuation characteristics of ice hockey helmets change over time for 4.5m/s impacts. The data will help inform an evaluation of the expiry dates applied by certification agencies and contribute to the improvement of injury prevention and reduction strategies.

[1] Pearsall et al., 2008; [2] Pearsall et al., 2016 [3] Mihalik et al., 2012 [4] Agel et al., 2007