Testing of a hockey helmet and novel liner material in two rotation-inducing test methods

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Introduction
Impact tests in contemporary helmet standards do not replicate the rotational response of the head in an impact [1]. The rotational response of the head is thought to be closely-linked to the mechanisms of brain injuries such as concussion [2]. Methods for producing more realistic, rotation-inducing, head impacts in the lab have been proposed for various helmet applications [3, 4] but are not yet introduced to standards.

Objective
Compare the headform response of a commercial hockey helmet to design iterations incorporating a novel liner material in two rotation-inducing headgear impact test methods.

Methods
Test helmets
An unmodified, commercially-available, ice hockey helmet and liner design iterations incorporating modular components of a novel auxetic and anisotropic liner material were tested.

Results
The average peak linear and rotational headform accelerations in the head-first drop tests are shown in Fig 3 and in the linear impactor tests in Fig 4. Changes in helmet liner design had a varying and inconsistent effect on the peak headform responses across the head impact configurations tested.

Discussion
Design changes to the helmet liner shows some promise in reducing peak rotational accelerations of the headform in certain head impact configurations, particularly head-first impacts onto a 30º surface and obliquely oriented linear impactor events. The impaired or unchanged helmet performance in other configurations highlights the need for a considered approach to headgear design and impact testing. Impact test methods should reflect real-world impact orientations and their frequency as well as the resulting injury types, severities and frequencies.

References

Acknowledgements
The financial support and collaboration of Helios Global Technologies Inc., Kelowna, BC and the financial support of MITACS is gratefully acknowledged.