McMaster University

McMaster Injury Biomechanics Lab

Evaluation of Commercial Hockey Neck Guards via a Novel Instrumented Test Surrogate

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INTRODUCTION

- Direct hockey puck strikes to the neck can produce serious and/or fatal injuries
- BNQ 9415-370 standard only protects against skate lacerations, no consideration of blunt impacts
- No surrogate exists with realistic stiffness (for force response) and shape (for fit) of the neck

OBJECTIVE

- To develop an instrumented surrogate that accurately represents the neck, and evaluate commercial neck guards for their force attenuation under simulated hockey puck impacts

METHODS

- A surrogate was developed using a mannequin body with a force sensor and spring installed at the neck (Fig. 1a)
- Neck spring stiffness was determined via puck impact simulations on the THUMS human body model
- Five experimental impacts (32.6 J, equivalent to 46 mph hockey puck) were performed on three commercial neck guards using a puck-mounted projectile in a pneumatic impacting apparatus (Fig. 1b and c)
- Peak force, coefficient of variation (CV) and percent force reduction of each neck guard (relative to unpadded) were calculated from an integrated force sensor

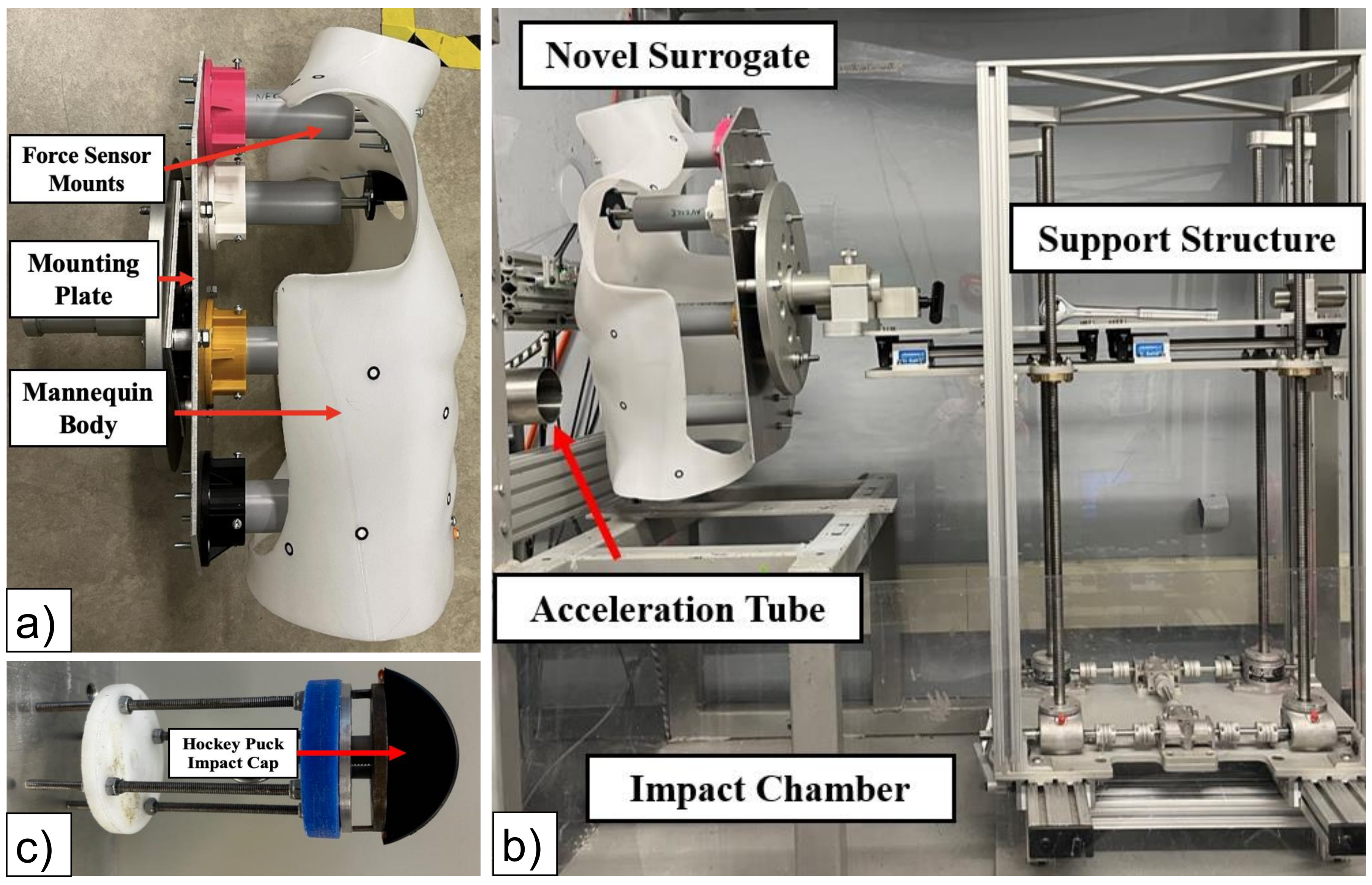

Fig. 1: a) Side view of surrogate, which was mounted in b) the impacting apparatus. Impacts were applied using c) a projectile with a hockey puck cap, and protection was quantified by the embedded force sensor.

RESULTS

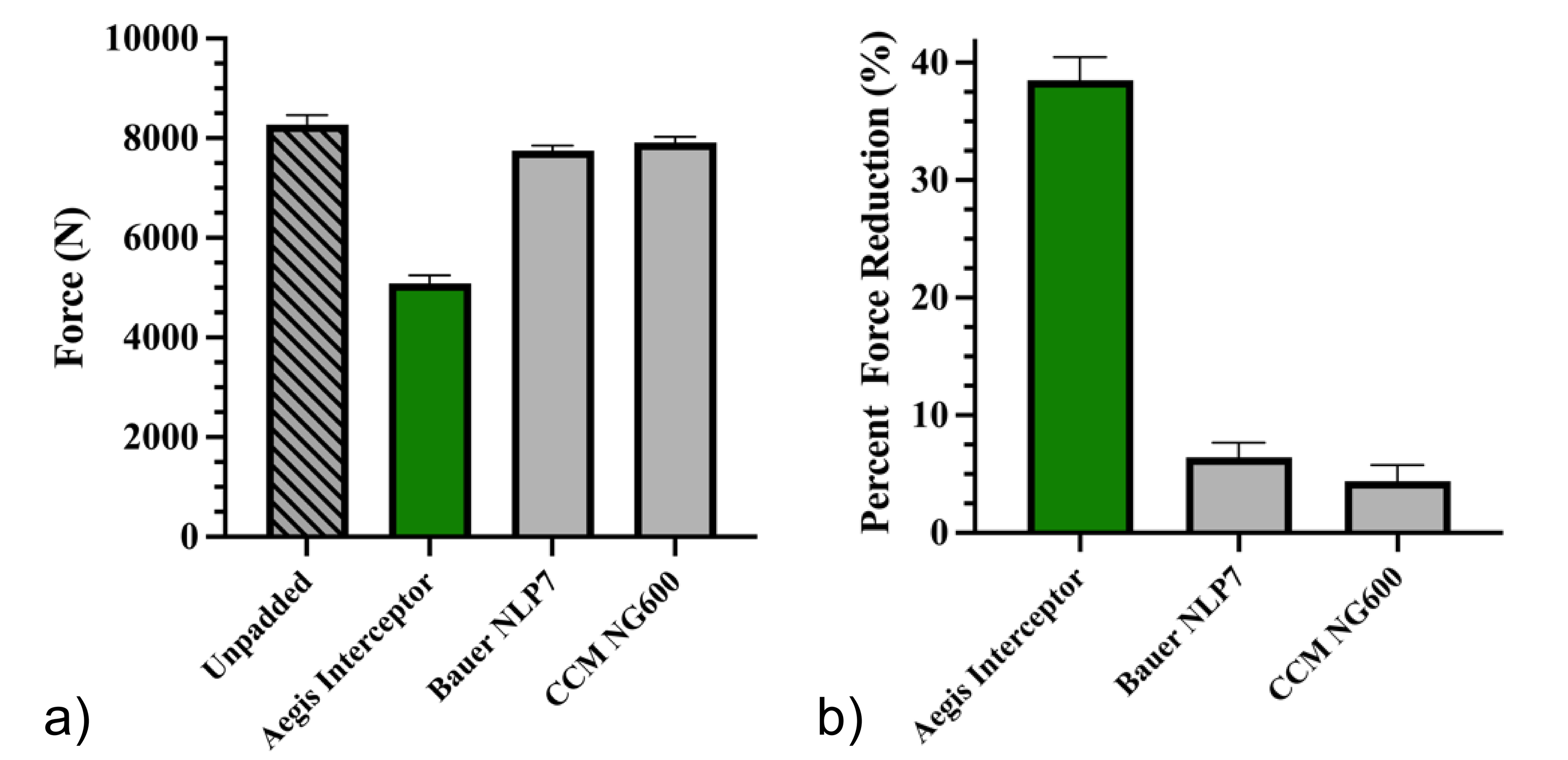

Fig. 2: Protection provided by commercially available neck guards. a) Peak force was measured by the surrogate force sensor. b) Percent force reduction was calculated relative to the unpadded tests. Green indicates the product that provided the greatest force reduction from the unpadded condition (grey hatched bar).

- Surrogate repeatability was high across all four testing conditions (CV ≤ 3.2%, N = 5 per condition)
- Unpadded impacts resulted in a mean peak force of 8277 ± 186 N (Fig. 2a)
- Aegis Interceptor neck guard provided the greatest peak force reduction (39%) (Fig. 2b)
- The Bauer NLP7 and CCM NG600 provided minimal impact protection, with only a 6.4% and 4.4% peak force reduction, respectively

DISCUSSION

- Aegis Interceptor is the only neck guard tested that was designed for impact protection (Fig. 3)

Fig. 3: The greatest protection was found with the Aegis Interceptor, the only guard tested that had an energy absorbing insert for blunt impact.

- With no known injury limits for the neck under blunt trauma, cannot say whether protection was sufficient
- Neck guards also must consider comfort and usability to ensure player acceptance, which was not investigated in this study
- This work is an important first step towards establishing comprehensive test standards for neck guards that address blunt impact injury
- Future neck guards should consider this injury mechanism in their design

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