DURABILITY OF ICE HOCKEY HELMETS TO REPEATED IMPACTS

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INTRODUCTION

Various sports activities that involve protective head gear have different safety testing criteria (Hodgson, 1991). In ice hockey, helmets need to fulfill their function after multiple impacts. Current standards typically involve three repeated impacts at specified helmet sites at a specific energy (Newman, 1993). Since helmets may be used for several competitive seasons, the mechanical durability of these helmets is unknown (i.e. do helmets sustain their impact attenuation properties after numerous repeated impacts?)

METHODS

A monorail drop apparatus was used to conduct controlled impact tests according to standard CSA-Z262.1-M95. A uniaxial linear piezoelectric ± 500 g accelerometer (353B04 , Dalimar) was located at a headform's center (ISO, large size, M) to measure peak linear deceleration at impact (sampling rate 10 KHz; filtered at 1000 Hz) in g's (9.81 m/s/s). The helmet/headforms impact energy was set at 40 J. Three samples of five different models of helmet (size large) were used and four impact sites were evaluated: front, rear, side, and crown. Each site was impacted 50 times. Each helmet received a total of 200 impacts.

RESULTS AND DISCUSSION

Each helmet tested satisfied the safety test criteria at 40 J for the first three impacts (i.e.<275g). The side site showed higher g's than the other sites ($p<0.001$,Fig 1). After several impacts the degradation in impact attenuation properties would plateau and, in some model sites, peak g's would eventually exceed 275g's. The rate of attenuation properties varied with site and helmet model ($p<0.05$, Fig 2).

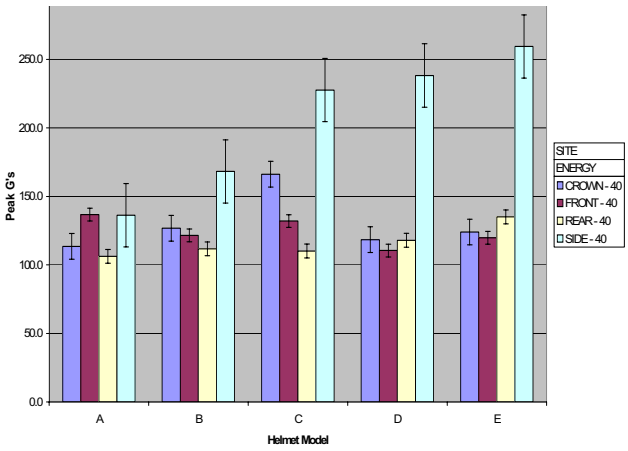

Figure 1: Comparison of peak G between the sites and helmet models at the third repeated impact.

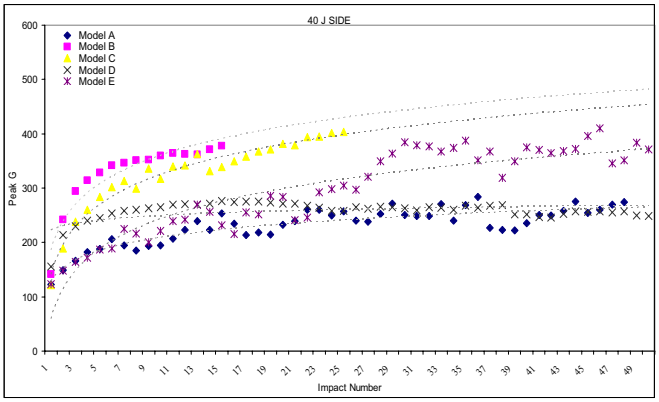

Figure 2: Comparison of side impact site peak G measures by helmet models for up to 50 repeated impacts.

The gradual decrease in impact attenuations properties (i.e. increased peak G with repeated impacts) varied with helmet model due to various liner padding materials, shapes, thickness, and outer shell geometry.

CONCLUSIONS

The above results help to predict the behaviour of helmets under an extreme number of multiple impacts. It also showed the heterogeneous impact response by helmet site; notably different for side impacts. This information may assist in establishing the expected lifetime usage for helmets. Safety standard committees, manufacturers, and national ice hockey associations need to consider this information carefully. Further study is needed to determine the typical mechanical stability of helmets over a normal season-to-season use.

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