EFFECTIVENESS OF INFLATABLE HIP PROTECTORS

Ehsan Arjmand¹, Siamak Arzanpour¹, Stephen N. Robinovitch²,³
¹ Department of Mechatronics, School of Engineering Science, SFU, Surrey, BC
² School of Engineering Science, SFU, Burnaby, BC
³ Department of Biomedical Physiology and Kinesiology, SFU, Burnaby, Canada

INTRODUCTION
Wearable hip protectors (padded garments) are a promising approach to hip fracture prevention. These devices reduce fracture risk by attenuating the impact force applied to the proximal femur during a fall. They are made from either soft or hard foam rubber or plastic materials. However, it is likely that inflatable hip protectors can provide considerably greater force attenuation than current passive devices. Due to the more complex design and fabrication challenges (and likely cost to consumers), they must provide more considerable protection than currently available devices to justify the feasibility of this option. Toward this end, efficiency of these type of hip protectors (as opposed to passive padded ones) is examined and the parameters contribute to their efficiency are emphasized.

METHODS
In this study, three inflatable hip protectors in different sizes, termed as large, medium and small, fabricated from a non-elastic material (vinyl) as shown in figure. SFU Hip Impact Simulator is utilized to measure the force attenuation provided by each inflatable hip protector (Figure. 2). Moreover, in order to compare the efficiency of inflatable hip protectors with commercially available ones, we take advantage of the study conducted by Laing et al 2011 [1] where a comprehensive comparison of 26 commercially available hip protectors reported.

RESULTS & DISCUSSION
Force attenuation for small inflatable hip protector was observed to be equal with the force attenuation provided on average by commercially available passive hip protectors at an impact velocity of 2 ms (Figure 3). The medium and large inflatable protectors provided 1.5 and 3 times the force attenuation provided on average by passive devices. The results, also, indicate geometry, to a large extent, influences force attenuation. In contrast, the force attenuation tends to increase with increasing impact velocity (contrary to passive devices). For example, percentage of force attenuations for large, medium and small inflatable hip protector at impact velocity of 1 m/s are 58%, 29% and 18% respectively, whereas at impact velocity of 2 m/s the figures increase to 61%, 32.5% and 22.5%, indicating direct relation of impact velocity and force attenuation.

Figure 2: Simon Fraser University hip impact simulator. A surrogate pelvis is mounted on the end of an impact pendulum. A load cell located in the femoral neck measures the force applied to the proximal femur during a simulated sideways fall.

Figure 3: Comparison of the biomechanical efficiency (attenuation in peak femoral force) at an impact velocity of 2 m/s between commercially available hip protectors and inflatable devices. SIHP: Small inflatable hip protector under study, MIHP: Medium inflatable hip protector, LIHP: Large inflatable hip protector.

REFERENCES