Concussive Forces and Brain Trauma in Competitive Sports

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Background
Concussions are the most common type of traumatic brain injury. They are typically caused by severe head impacts, which cause the soft brain tissue to make contact with the inside of the skull, often resulting in temporary neurological impairment.

In 2009, hospitals reported 24,184 cases of soccer head injury, and 28,716 cases of water sport head injury (American Association of Neurological Surgeons).

Overall Objective
The primary goal of this research is to determine whether ball inflation pressure has a significant impact on traumatic brain injury. Auxiliary goals include assessing the effectiveness of Kap7 headgear in water polo for preventing TBI and CTE, and testing the accuracy of the new G-Force head-strap accelerometer.

Winter Quarter Testing
Our testing procedure consists of launching soccer and water polo balls at an Anthropomorphic Testing Dummy (ATD) head at various speeds and ball pressures, as listed in the table below.

<table>
<thead>
<tr>
<th>Pressures (psi)</th>
<th>Water Polo</th>
<th>Soccer</th>
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<tbody>
<tr>
<td>10, 12, 13, 14, 15, 17</td>
<td>5, 7, 8, 9, 11</td>
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<table>
<thead>
<tr>
<th>Velocities (mph)</th>
<th>Water Polo</th>
<th>Soccer</th>
</tr>
</thead>
<tbody>
<tr>
<td>35, 40, 45, 50, 55</td>
<td>35, 40, 45, 50</td>
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The ATD head from Humanetics is equipped with six accelerometers (piezoresistive and angular rate sensors). They measure G force accelerations in x, y, and z axes.

The data acquisition system automatically calibrates and arms the accelerometers to expect an impact. As soon as the ball collides with the head, the accelerometers take data for about 0.7 seconds at a sampling rate of 10000Hz.

The preliminary results for water polo at 40mph are shown in this graph. Impact acceleration increases with increasing ball pressure and decreases with the use of headgear.

Current Status
Our experimentation has concluded, and we are now in the data analysis phase of the project. After weeks of testing, we have a substantial amount of data, so the analysis will take some time. We are currently developing our analysis procedures to ensure accuracy and consistency.

Next Steps
With our experimentation completed, we will begin to analyze our data thoroughly. Once all of the data has been analyzed, we will form our conclusions and being creating our official report.

Timeline