Headgear for Soccer Players

Isaac Barbour¹, Nikole Connor², and Elisabeth Jeyaraj³

Approximately 225,000 patients per year suffer from a concussion, which is a mild form of traumatic brain injury (TBI) that is caused by a bump, blow, or jolt to the head (Delany et al. 2002; “A Fact Sheet for Teachers, Counselors, and School Professionals” 2010). The severity of the concussion is dependent upon rotational or linear forces that result in acceleration and deceleration of the brain around its midpoint. These brain injuries can be especially detrimental to collegiate athletes under the age of 20 because their brain is still in the developing stages. Participation in sports increases the risk of a TBI or concussion. In one study, 62.7% of soccer players experienced at least one concussion during a season, and once an athlete suffers from a concussion, they are three times more likely to experience another concussion (Guskiewicz, McCrea, and Marshall 2003). The growing number of concussions shows that there is a need for headgear that can help alleviate concussion-causing accelerations.

Headgear designs specifically for soccer have developed within the past ten years; many of these designs were meant to address different aspects of sport related brain injury. In a study, it was found that an average person can withstand 66 g linear acceleration with only a 25% chance of a concussion, and 106 g linear acceleration was determined to have an 80% chance of concussion (Zhang 2004). Current products on the market do not successfully attenuate the required accelerations. According to Lehner in 2010, the leading competitor only decreased linear accelerations by 3.54%, and rotational acceleration by 3.45%. The goal of this project was to address existing gaps in the efficacy of the headgear; therefore, design considerations were alleviating accelerations, thermal regulation, cost, and adaptability, while not limiting the users’ mobility during game play.

The team’s methodology included three major components: material selection, rotational acceleration testing and general design analysis. For material selection, the team used an Instron Dynatup impact machine to determine the force attenuation of Dow Jones’ Impaxx and Rogers Corporation’s Poron XRD foams. It was concluded that Poron XRD experienced a lower peak force than Impaxx, as well as increased the duration of collision. Thus, the team constructed the headgear using Poron XRD (3/8 inch thickness). Additionally, wicking tests were completed on several fabrics, and Patagonia Capilene Polyester was selected for fabric usage. To determine rotational accelerations during collision, two experimental procedures were used. The first was the Helmet Crash Test at the Connecticut Science museum, which utilized a 5 kg swinging arm and a Hybrid III head-form. Data from this test showed that the team’s design decreased accelerations by 14% at a drop of 4.5 ft, when compared against a control. The second acceleration test was an independently constructed system that guided a head-form to 3.9 m/s, at which point it collided with a headgear protected head-form instrumented with two uniaxial ADXL001 accelerometers. From the data, it was determined that the headgear successfully decreased accelerations. The final area of methodology was general design analysis, which measured thermal regulation, adjustability, and fit. The study was approved by the Institutional Review Board, and used competitive university soccer players. Thermally, the design only increased the skin temperature of the side of the head by an average of 2.9 °F during exercise. When the internal body temperature of an athlete is increased by 3 °F from normal, there is little to no health risks. Heat stroke begins when core temperature is raised 5 °F. For comfort, the users scored the headgear with an average of 8.8 before exercise and 7.2 after exercise on a scale of 1-10, with 10 being the most comfortable. The users also scored fit at 4.4 before exercise and 4.9 after exercise on a scale of 1-10, with 1 as the loosest and 10 as the tightest.

¹ Worcester Polytechnic Institute, PO Box 2227, 100 Institute Road, Worcester, MA 01609. concussions@wpi.edu
Overall, the prototype developed by the team was a success. The headgear addressed the existing gaps in the efficacy of competing products and met the team’s objectives. Future recommendations for product development would be to conduct further testing. Suggestions include comparative studies with competitors, investigation into the usefulness of the headgear when at higher g acceleration ranges, as well as more studies relevant to rotational accelerations.

Works Cited


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