

## **Concussions, Head Injuries and the Textile Industry**

**C. J. Abraham, P.E., Phd, JD, FTI, FRSC, DEE, BCEE**

According to the Federal Centers for Disease Control in the United States and Michael Collins, Ph.D., a neuropsychologist affiliated with the University of Pittsburgh, there are 3.8 million sports-related concussions per year in the United States, most of which go undiagnosed. Unfortunately, contact sports as well as some recreational sports carry risks for serious head injury. While many people may think that this is obvious, most are not aware that small repetitive brain injuries can cause long-term damage. There is documentation that continuous or additional sub-concussive level impacts can result in long term neurological deficits that manifest themselves over the course of their playing time or after the individual is retired from the sport. In fact, sub-concussive impacts can easily result in reducing the threshold of temporary and/or permanent brain injuries. Unfortunately, there isn't one helmet in the world that can prevent a concussion. Cumulative sub-concussive head injuries can cause debilitating memory loss, chronic headaches and clinical depression.

By incorporating a specific polymeric absorbing material with memory into a cotton/Spandex headband, the patented Forcefield FF headband solved the problem for the sport of soccer. The headgear was independently tested and approved by every soccer organization in the United States and received the CE II Mark in Europe and the designation as "protective headgear."

When one develops a product with the intent of placing it in the stream of commerce, there are several variables that one must consider prior to investing time, energy and funds.

They are the following:

- 1. Need for the product: the product must have redeeming qualities and the needed by a specific segment of the population. The number of potential customers must be sufficient to satisfy the investment.**
- 2. Patentability of the product: if the product is not unique and patentable it can be copied and produced by anyone who so desires.**
- 3. The design: the product must be designed so that it does not appear to look like headgear or a helmet. If it does, the soccer players will not wear it or purchase it. However, the product must still possess capabilities to protect those involved in contact sports. It must also be able to mitigate potential injuries to the most vulnerable areas of the head and brain.**
- 4. Projected market: if the projected retail market is in the millions, then the product has a chance of success if a small fraction of the potential sales is achieved.**
- 5. Cost of product: the cost of the product must be at a level so that the wholesale and retail price of the product will be purchased by the largest segment of the intended purchasers.**
- 6. Approval as protective gear by sports organizations: if the product cannot be worn as part of the equipment by players in soccer and/or other sports, then the product cannot be sold. It would be essentially useless even though it would serve a purpose in reducing the risk of head injuries. Therefore, applications and testing by independent laboratories have to be performed and submitted to the various agencies for approval.**
- 7. Advertising and sales-methods of reaching the intended buyers must be available at a reasonable cost.**

## **Need for the Product**

**Unfortunately, contact sports as well as some recreational sports carry risks for serious head injury. While many people think that this is obvious, most are not aware that small repetitive brain injuries can cause long-term damage. There is documentation that continuous or additional sub-concussive level impacts can result in long term neurological deficits that manifest themselves during participation or after the individual is retired from the sport. In fact, sub-concussive impacts can easily result in reducing the threshold of temporary and/or permanent brain injuries.**

**Contact sports such as football, soccer, ice hockey, lacrosse or mixed martial arts, probably did not exist in the 5<sup>th</sup> century B.C. nor did motorcycling or bicycling. However, the importance of the brain and its contribution to one's quality of life was appreciated as far back as Hippocrates. Hippocrates documented the fact that the brain is the most important organ in our body. If that is true, why are so many young children, teenagers and adults constantly placing themselves at risk and compromising their quality of life with the possibility of a brain injury whose effects could be temporary, permanent or delayed.**

**Unfortunately, there isn't one helmet in the world that can prevent concussions. Furthermore, it is common knowledge that one does not have to receive a blow to the brain to experience a concussion nor does an individual have to receive concussive blows above the protected threshold level. The one of the main objective of protective helmets in sports is to reduce and/or eliminate subdural hematomas caused by contact with the helmet itself. The industry has been reasonably successful with respect to that type of injury. However, it is impossible, based upon the technology available and other variables, to entirely eliminate sub-concussive and concussive injuries.**

**Although still not widely known, it is now accepted by pediatric neurologists that children, especially infants and those to the age of seven, have substantially higher vulnerability to neurological trauma than adults. Some of the long-term effects do not manifest themselves until the child reaches adulthood (Jeanette). Dr. Cynthia L. Bealieu recently published findings showing that children who sustained injuries in the first five to six years exhibited less recovery and a greater impairment to intellectual skills as compared with children between six and sixteen. The age at which the injury was received and its severity dictates the rate and extent of recovering from deficits in language, memory, attention, and academic and decision-making skills (Beaulieu).**

**Italian researchers have suggested that soccer players are six times more likely to develop motor neuronal disease (MND) than the general population. The illness is incurable. British neurologists have connected illnesses such as MND, Parkinson's and Alzheimer's to repeated brain trauma even without receiving a concussion. Heading the ball, impacting of heads, or an elbow into the temple of the soccer player can be the precursor to the ultimate neurological problem. In fact, in 1974, the Sunday Times in Britain reported coroners' findings relating to deaths that were directly caused by heading in soccer. It is only through well-directed epidemiological studies that the accumulated data from the past can now be accurately analyzed. In spite of these older reports, players still refuse to protect themselves.**

**A London neurologist, Professor Andrew Lees, studied the case of Ray Kennedy who developed Parkinson's disease soon after helping Liverpool win three European cups. He concluded that Kennedy's illness could have been detected 14 years before he was diagnosed at the age of 35. It is also known that Jeff Astle died at the age of 59 from brain injuries caused by repeated hitting soccer balls in his 20-year career.**

**Ballistic engineers at the University of Glasgow demonstrated that a soccer ball can approach a speed of 80 miles per hour prior to impacting with one's head. It should also be noted that Billy MacPhail, a player with the Glasgow Celtics in the 1950s was disabled with pre-senile dementia and died in 2003. Other soccer players of note who were impaired was Jimmy Johnstone who was diagnosed with ALS in 2002; former England manager Don Raveie with ALS; Derby's Rob Hindmarch with ALS and Middlebrough's Willie Maddren with ALS.**

**In 1992, a Norwegian study found that 35% of active soccer players in that country had abnormal brain scans, and another study in that country of retired players found that one-third of them had brain atrophy and a shrinking of brain tissue that resulted in behavioral and congenital problems. The study concluded that the damage was directly related to sub-concussive repeated hitting. Although young children and teenagers do not experience the extreme force of the ball of professionals, their skulls have not matured and are constantly at risk.**

**There is no method of reducing the risk of head injuries when a player is hit in other parts of his/her body and not the head. The percentage of head injuries that relate directly to head impacts, relative to impacts to other parts of the body that also result in head trauma, cannot be reduced with any type of protective equipment.**

**Year-round, sports are the leading cause of injuries in the 11-to-18 population. The United States Center for Disease Control and Prevention estimates that one-half of the one million plus sports injuries seen among young children each year could be avoided with proper education and the use of protective equipment. The assumption here is that injuries reported do not involve organized contact sports.**

**Dr. Kevin Guskiewicz, director of The Sports Medicine Research Laboratory at the University of North Carolina at Chapel Hill, has stated, "While many parents and athletes think that concussions rarely occur in sports such as lacrosse, soccer, softball and baseball, recent data suggest that concussions occur more frequently in these sports than previously thought."**

**In the United States, soccer is second to football in the incidences of concussions in children playing sports. Data is mounting on the long-term effects on the brain. Medical literature discusses significant risks of permanent brain injury in serious soccer players. It has been demonstrated that there is a high incidence of concussions among youth soccer players and the American Academy of Pediatrics classified soccer as a "contact/collision sport."**

Research at McGill University has shown that over the course of one year, approximately 2/3 of University soccer players will have symptoms of a concussion after being hit in the head playing soccer. It is not only researchers who know that concussions in soccer are a real problem. Even the US government has realized there is a problem. The United States Consumer Product Safety Commission (CPSC), a government organization, collects data from selected hospital emergency departments from across the entire U.S. in an effort to estimate the total number of injuries occurring during specific activities and/or injuries occurring with specific products. The CPSC uses the National Electronic Injury Surveillance System (NEISS) figures based on a sample of participating U. S. hospital emergency departments rather than a consensus of all US hospital emergency departments. It is estimated that there are approximately 3.8 million concussions resulting from participation in sports and recreational activities in the United States alone.

A recent estimate of the number of registered soccer players was approximately 260,000,000. Soccer is the most popular sport in the world. It would seem obvious that if a product could be designed to reduce the risk of head and brain injuries to young children and adults, it would serve a desirable purpose and have redeeming qualities.

#### **Patentability of the Product**

Based on the foreseeable use of the proposed product, one has to apply his/her background in textiles, polymers, manufacturing and costs to designing a product to be used in the sport of soccer and for other recreational activities. The first thing that has to be completed after the concept is conceived is to perform an extensive patent search to determine if the product is unique and patentable.

A search of the headband was performed going all the way back to 1895 and up to 2003. Initially, the search indicated that the proposed design was unique and had a chance of being patented. The first United States patent was applied for in August 22, 2002 and the patent was eventually issued on January 13, 2004 (US 6, 675, 395).

#### **Designing the Headband/Headgear**

The product was described as a sweatband designed to be worn on the head of the user engaged in activities such as soccer. In the preferred mode, the device comprises a horizontal sweatband portion, much like a typical headband. The sweatband also contains inserts for the purpose of protecting the user. The inserts are polymeric and function to absorb and dissipate impact forces with which the head may come in contact. Most importantly, the inserts are strategically placed within the sweatband in such areas most vulnerable to concussion or injury upon impact. The product is able to absorb and dissipate perspiration and is lightweight. An additional patent was issued (US 6, 978, 487, June 26 2007). This patent clarified the method by which the design allowed for breathing through the headband and allowed the perspiration to be dissipated.

The headgear looked and behaved like an ordinary sweatband. It absorbed and dissipated perspiration but, more importantly, was able to absorb and dissipate a significant amount of impact forces to both children and adults. In addition, its appearance conformed to the outfits or uniforms of the players.

**Although the subject of concussions is extremely important in all contact sports, there is a continual denial by participants in the sport of soccer that heading the ball affects the brain. In spite of numerous newspaper and medical reports about star players from the past and present documenting that continuous sub-concussive impacts can result in long term neurological deficits, soccer players continue to have an attitude that nothing can happen to them.**

**Therefore, it was important to design a product that would not look like a helmet but still be able to significantly reduce the severity of impact to the brain. The Forcefield FF headband was the solution to the problem. It looked just like a headband and had all of the components of a sweatband, in addition to the capability of absorbing and dissipating impact forces in the sport of soccer in every aspect of the game.**

### **Choice of Textile and Polymeric Materials**

**When one creates protective headgear is important to evaluate the potential materials that are required to put the product together with reference to all of its foreseeable uses and misuses. The headband/headgear will be exposed to all types of weather. It will also be exposed to UV rays, abrasion, constant perspiration and impacts with a soccer ball, player's bodies, the ground and goalpost.**

**There were a variety of sweatbands in the stream of commerce that were composed of cotton and Spandex and were holding up well for the limited purpose as a sweatband. The next step was to determine what polymer should be used in conjunction with the headband that would be able to absorb and dissipate a significant amount of impact force and have little or no affect on the playing of the game of soccer. The polymer had to have excellent memory so that it could return to the original configuration rapidly and would be able to duplicate its reaction to repeated impacts indefinitely. In addition, the polymer had to withstand the same exposure as the headband itself.**

### **Testing of Prototypes**

**Testing of a large number of prototypes was performed using the extensive experience of the author. He tested every type of protective headgear manufactured for every contact and noncontact sport over a forty year period. Rather than use the low impact force approved for soccer headgear, Dr. Abraham used the drop test used to test ice hockey helmets, ASTM F1045. The results documented that the absorption and dissipation of forces passed the shock absorption test for ice hockey helmets. In this case however, the Forcefield FF headband did not have a hard polycarbonate cover. It looked just like a regular sweatband. The test results are posted on [www.forcefieldheadbands.com](http://www.forcefieldheadbands.com).**

**The original testing was verified when the Forcefield FF headband received the CE II Mark in Europe after six months of testing. Independent tests performed at McGill University documented that young children would experience up to 83% reduction in impact forces when a soccer ball came in contact with their heads. Additional testing at Intertek Laboratories in Cortland, New York further documented those results using impact tests required for ice hockey helmets. Additional tests involved UV exposure,**

testing at low and elevated temperatures as well as exposure to moisture and its effect on the absorption and dissipation of impact forces. In comparison, a regular sweatband does not absorb and dissipate impact forces.

### **Designing the Packaging of the Forcefield FF Headband/Headgear**

The product was designed and packaged meeting two objectives: selling the product on the Internet and wholesaling the product to the retail market such as chain stores carrying sports equipment and sports stores.

In order to mail the product, it and must be designed so that the packaging conforms to the size and shape of the headband and must also fit into the headband display area in stores. The packaging must also be small enough so that it can be mailed. The printing on the packaging must meet the requirements for retail sales as well as the legal requirements. The legal requirements involve the warnings and instructions and the claims. The final packaging is shown on the Forcefield FF web site: [www.forcefieldheadbands.com](http://www.forcefieldheadbands.com)

### **Selling the Product**

It is very difficult to sell products of any type without significant backing. However, one runs the risk of not knowing what the working relationship with any potential investor will be and whether the original owners will be in control in the future. In many instances, investors usually wind up with the company and take what they can as quickly as possible.

It would seem obvious that showing the product at various trade shows might be the first effort one would make in attempting to find distributors and retail sales. The cost for booths and the effort and time involved was not beneficial even though several hundred headbands were sold at each show. The chain stores require delivery of your product without payment for 60 to 90 days. However, one is lucky to receive payment in this economy within the year. This is not a healthy approach for a small company with limited funds. For example, a major sports store sent in a second large order when they hadn't paid for the initial small trial order.

A web site was created and selling directly to the public was started through Google and other search engines. This was moderately successful. Increased sales were immediately realized once the company advertised on Facebook. In addition, a number of inquiries came from distributors in Europe, the Caribbean, Canada and South America. Even a number of small sports stores made inquiry.

The largest offer came from representatives who dealt with every major sport store in the United States. They needed a large warehouse and a full staff to coordinate the distribution throughout the United States. Unless there is a backing of several million dollars, their offer to sell the product could not be met by a small company. In addition, there was no guarantee of payment within 30 or 60 days based upon prior experience with a major chain. The other alternative is to request that the major chain pay for at least half of the order up front and the rest within a certain period of time. That is not the usual protocol followed by major chains.

**Therefore, whatever success one experiences will be based upon the web sites on the Internet, recommendations and acceptance by soccer players throughout the world.**

**C. J. Abraham has spent the last 40 years consulting internationally on many personal injury cases and also invented and commercialized a variety of products. Over the last 30 years he has tested and evaluated a large variety of protective helmets designed for every contact and non-contact sport and recreational activities. He is certified and has diplomat status in a number of areas. His background and experience can be found at [www.scientificadvisory.com](http://www.scientificadvisory.com). He thanks Sharon G. Bickler, Esq. for her editing and contribution to this paper.**