

Optimization of Headgear Design to Reduce the Head Injury Risk in Football

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Abstract Headgear is one of the protective tools used by soccer athletes, this tool is made to protect the player's head so that it reduces the risk of injury. However, there are many cases where the players who use this tool feel uncomfortable because it was with an uncomfortable material. If the user is looking for a comfortable headgear, the headgear does not actually provide protection according to standards. Therefore, the authors do optimization on the headgear protective tool to allow the tool to provide optimum security but also provide comfort to the user.

Keywords: *Headgear Design, Risk Reduction, Football.*

1. Introduction

Sport is an activity carried out by humans to meet physical needs, can as a form to maintain health, as a hobby, or to compete professionally. Sports have a lot of branches and these branches have their respective procedures, by exercising someone exercises physically to be able to work in accordance with certain sports procedures, if someone does sports procedures incorrectly then there is a risk of injury.

Football is one of the many sports that has long been found and is very popular with many sports lovers of various ages, soccer is a sport that actually includes hard physical contact, physical contact that occurs if not given protection can cause injury. Based on a survey conducted by NCAA (National Collegiate Athletic Association) in 2004-2009 there were more than 55,000 cases of injury from 7.1 million athletes with 5.5% head injury, 4.3% neck, 6.2% shoulder, 14.7% back and waist, 65.6% of the legs, and 3.7% other injuries.

In this study the author performed an optimization of one of the protective tools that can be used by soccer athletes, namely headgear to reduce the risk of head injuries, head injuries in soccer are not many injuries that have been proven by the survey from the NCAA but injuries to the head is very impactful on an athlete's career, if an athlete suffers a severe head injury then he must undergo medical treatment and may not be able to take part in the competition for a long time, and if the injury is really severe then the athlete may be forced to retire early.

The cause of head injuries is largely due to the occurrence of a fairly hard collision between the head of the player with the head of other players, other players' feet, goalposts, etc.

To Reduce the Head Injury Risk, the authors optimized the headgear by replacing the base material from the padding to increase the safety level of and provide a removeable padding feature to give the user freedom of the protected part.

2. Basic Theory

To create a comfortable and safe headgear, knowledge about designing something that is effective and efficient is needed. The knowledge is called ergonomics. Ergonomics makes the design of the product that will be made to affect the user and can optimize the ability of a product. Here are the main objectives of this knowledge:

- 1) Improving human comfort in using a product.
- 2) Reducing product failure due to human error.
- 3) Improve the quality of the product produced

To support ergonomics, other disciplines such as anthropology, psychology, and engineering are needed.

A good headgear needs to have a feature that not only protects the user's head but also keeps the head comfortable during use, to meet this need a balanced ratio of safety to comfort must be fulfilled, if the headgear is made too focused on safety it will certainly add burden to the head so that it will makes it difficult for the player to control the ball with his head and can also make the head feels hot, but if the headgear is made too focused on comfort, the wear and tear feature is absent and the headgear is useless.

3. Results and Discussion

The steps taken to optimize headgear are as follows:

1. Determine the features that are needed by consumers, listed in table 1

Table 1 Headgear features that consumers need.

No	Feature
1	Has a padding that absorbs impact well
2	Has a padding with the right thickness
3	Has a padding that is lightweight
4	Does not make the head become hot
5	Has a strong strap but does not hurt the head

2. Next, measure the dimensions of the headgear according to the average head size of a professional soccer player. The right size makes wear comfortable and avoids injury due to the aid of a tool.
3. After measuring the dimensions of the headgear, the next step is to create a design based on customer needs. The results of this headgear design optimization are shown in Figure 1.



Figure 1 Headgear design. The specifications of the Headgear design are in Table 2.

Table 2 Headgear design specification.

No	Specification
1	Main Body: 55 cm (according to the average head circumference of

adults aged 25 years)

- | | |
|---|--|
| 2 | Removable 3LB density foam pads: Thickness 50 mm |
| 3 | Soft cool straps: lightweight nylon |
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Discussion

The making of headgear with dimension specifications as in Table 2 is in accordance with the science of ergonomics to reduce the risk of head injuries in soccer. In terms of the material itself, the basic material / straps are made of lightweight nylon because the material has a flexible texture and does not retain heat so as to provide coolness when used.

Padding on this headgear has a thickness of 50 mm made of 3LB density Foam where this material is able to withstand heavy impacts temporarily but does not burden the head, besides that the padding on this headgear is removeable where the user can move the padding to adjust their needs and also makes it easier for users to clean and replace when damaged / torn and also available in various types of colors to suit the user's desires.

The materials used for this tool are easy to obtain but have a relatively expensive price, but with features that can be given this tool can certainly be able to Reduce the Head Injury Risk but still make the user feel comfortable.

4. Conclusion

Optimization of headgear to Reduce the Head Injury Risk is in accordance with the provisions of protective equipment made by FIFA and can be mass produced by the sports equipment industry because the required materials are easy to obtain, but have relatively expensive prices.

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