



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN AND DEVELOPMENT OF
PROTECTIVE HEADGEAR IN LESSING HEAD
IMPACT DURING CONCUSSION FOR RUGBY
GAMES**

This report is submitted in accordance with the requirement of the
Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of
Mechanical Engineering Technology (Maintenance Technology) with
Honours.

by

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2018

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Design and Development of Protective Headgear in Lessening Head Impact during Concussion for Rugby Games

Sesi Pengajian: 2019

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DEDICATION

I dedicated this report to my beloved parents, supervisor and friends for their support, and great guidance to complete the bachelor degree project successfully.

ACKNOWLEDGEMENT

First and foremost, praises and thank to Allah S.W.T, the Almighty, for His showers of blessing to complete this final year project successfully.

I would like to express my deep sincere gratitude to my project supervisor, Mr. Mohamed Saiful Firdaus Bin Husin, lecturer of Engineering Technology Faculty from University Technical Malaysia (UTeM). His sustained enthusiasm, patience and consistent guidance steered me in the right direction whenever he thought I needed it and now I can have my final year project completed successfully.

I am extremely grateful to my parents for their love, caring, prayers and sacrifices for educating and nurturing me for my future. Their wise counsel and sympathetic ear have always comfort me. I have never short of any necessities all the way as they do know and prepared what I may need.

ABSTRAK

Headgear ragbi adalah suatu alat pelindung yang penting bagi melindungi kepala para pemain ragbi daripada terdedah atau berlakunya kecederaan yang tidak diingini. Penggunaan headgear di dalam sukan ragbi semakin meluas saban hari. Bagaimanapun, masih terdapat sebahagian para pemain ragbi professional mahupun amatir tidak begitu menitik beratkan hal tentang penggunaan headgear sebagai alat pelindung kepala. Headgear ragbi telah dicipta bagi melindungi kepala para pemain ragbi khususnya untuk mengelakkan kecederaan-kecederaan kecil seperti luka. Hal ini kerana, seperti yang diketahui sukan ragbi adalah suatu sukan yang memerlukan aktiviti fizikal yang kuat dan melakukan teknik-teknik yang kasar. Justeru, para pemain ragbi mudah terdedah kepada sebarang jenis kecederaan. Namun begitu, kemampuan headgear ragbi untuk melindungi daripada terjadinya gegaran otak masih lagi menimbulkan persoalan. Oleh itu, objektif bagi projek ini adalah untuk mencadangkan reka bentuk konseptual headgear ragbi dengan mengambil kira faktor bagi mengelakkan atau mengurangkan potensi untuk terjadinya gegaran otak. Metodologi yang digunakan adalah kaji selidik terhadap para pemain ragbi professional dan amatir untuk menentukan keperluan terhadap reka bentuk headgear tersebut, Peta Konseptual untuk perkembangan idea, House of Quality (HoQ) dalam menilai keperluan pemain ragbi, Carta Morfologi dalam menentukan konsep, Kaedah Pemilihan Pugh untuk pemilihan reka bentuk yang paling sesuai dan akhr sekali ialah analisi Ergonomik. Headgear yang berbentuk bulat dan menutup sebahagian besar kepala telah dipilih sbagai reka bentuk konseptual, bahan Sorbothane dipilih sebagai bahan teras, menggunakan 'valco strap' sebagai bahan pengikat dan penggunaan span dibahagian dalam kepala untuk keselesaan pemakai. Reka bentuk headgear telah mencapai 'grand score' 5 dalam analisis RULA yang bermakna kajian lanjut dan perubahan diperlukan pada masa akan datang.

ABSTRACT

Rugby headgear is an important protective tool for protecting rugby players from being exposed or unlikely to be injured. The use of headgear in rugby sport is widespread every day. However, there are still some professional or amateur rugby players who are not particularly concerned about the use of headgear as a protective device. Rugby headgear has been created to protect the heads of rugby players in particular to avoid minor injuries such as wounds. This is because, as is known rugby sport is a sport that requires strong physical activity and abusive techniques. Hence, rugby players are vulnerable to any kind of injury. However, the ability of rugby headgear to protect against the occurrence of brain shakes still creates a problem. Therefore, the objective of this project is to propose a conceptual design of rugby headgear by taking into account factors to prevent or reduce the potential for brain shakes. The methodology used is a survey of professional and amateur rugby players to determine the need for the design of the headgear, Conceptual Map for the idea of development, House of Quality (HoQ) in assessing the needs of rugby players, Morphological Chart in determining the concept, Pugh's Selection Method for The most appropriate design selection is the Ergonomic analysis. Headgear that is round and cover most of the heads has been selected as a conceptual design, Sorbothane material is selected as a core material, using valco strap as a fastener and the use of a sponge in the head for the comfort of the wearer. Headgear design has reached a grand score 5 in RULA analysis which means further research and changes are needed in the future.

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CHAPTER 1

INTRODUCTION

1.1 Background

Headgear is one of the essential safety equipment for numerous fields in the world such as in military, sport, medical and many others. Headgear is the device that worn on the head and give protection on covering head and it also usually called as helmet. There is study that said the origin of development of the headgear has been inspired from the animal skeleton that have horns, ossicones or antlers such as antelope and giraffe [1]. The making of headgear started with the cranial appendages ‘headgear’ where it contains of four existing form which is antlers, horns, pronghorns and ossicones. These days, the headgear has been through the evolution with technology and it is used depends on application. For instance, in the field of aircraft, where the aircrew safety and protective equipment starting to be introduced in the early years of 1900s to provide the safety and protect the aircrew from injuries and death [2]. At the end of the Second World War, the evolution of headgear or helmet for the aviator was frequently made from soft material that regularly in insulated leather and was intended to protect the aircrew from the effects of wind and cold while in the air. In the medical field, it was begun use in the late 1800s by the pioneer of American orthodontist where they have found the way to control the maxilla, the upper jaw that is in the central bone of the midface and thus of the facial portion of the skull and allow the mandible which mean the lower jawbone to catch up [3].

Rugby games is known as the full contact sport that has high potential to expose the player to the injury like lacerations and abrasions. Far-fetched American football and ice hockey that have utilize body cushioning and caps as insurance while in rugby recreations were forbid the utilizing of hard-shell protective cap and without body cushioning. Even though, there is still some wellbeing hardware that is allow by the International Rugby Board (IRB) [4]. The safety equipment is important to protect rugby player against injuries and head concussion. During this time, the usage of rugby

headgear is widely used by the rugby player, but it is still not mandated in the rule of rugby games as it becomes the option for the player whether they want to wear rugby headgear or not [5]. For instance, the Shawinigan lake High School the rugby team from Victoria, BC and the whole Japan country have set has the mandatory of wearing of rugby headgear as the compulsory for the rugby player. Canadian Rugby Union was suggested and advised for the rugby player to against its use to prevent head concussion because the lack of evidence [4].

The use of the rugby headgear is still recommended as the protection to prevent lacerations and abrasions besides to offer a limited protection from injury that causes by impact. The investigation comprised of a control, IRB has affirmed headgear display and an altered rendition of the IRB endorsed Canterbury Honeycomb demonstrate. The adjusted model was modified by expanding the front thickness. Effect vitality weakening tests were performed in the research facility, which demonstrated that the altered variant was unrivalled in its assurance capacities. The examination, in any case, addressed whether the dimensional changes that were made to the adjusted adaptation would be satisfactory to players and demonstrated that the investigation would need to additionally look at if the enhancements made to the altered variant would in undeniable reality convert into decreased damage rates [6]. International Rugby Board (IRB) also have manage and control the industry of protective wear and also to protect the rugby player with the issue relating to the specification the rugby head by highlight on the rule and regulation that entitled the specification relating to player dress and also the safety aspect of rugby boot sole design must be follow the general design guidance of the International Rugby Board (IRB) rules and regulations.

Currently rugby headgear in market has some disadvantages. In the previous works, researcher have founded the excuses from wearing the headgear even though many of rugby player usually realize about the awareness of important of safety equipment like rugby headgear [1]. This is due to the main and common excuses is it feel discomfort and distress when wearing the safety attire like the rugby headgear which is make, they feel like their head was being enclose and sheltered because some rugby head gear has no air ventilation and irritation while playing the rugby games due

to sweating and causes wet on their head. Besides, there are players have indicated that they have not found a comfortable scrum cap where lead them tend to ignore the important of wearing the safety attire like scrum cap. Next, they also claim that by wearing the scrum cap will make them feel too hot during playing rugby games and have stated that the scrum cap is too tight which is close fitting and not suitable for their big head [7]. The rugby player also has told that scrum cap has cause their senses becomes restricted by disturb their hearing while wearing which is it has harmed the cognitive functioning for instance, they unable to hearing clearly during the games [7]. In addition, rugby scrum cap also causes the obstructed and hinder of player vision view as they feel like need to see while wearing the scrum cap. Also, it is expensive to buy.

The usage of the rugby headgear also popular in preventing the injuries on the head and in avoiding the head concussion. There is some study that investigated the injury prevention effectiveness of the protective equipment such as scrum cap used in rugby union and the result was point out that scrum cap is available to provide the limited and decrease on the risk of injuries such as harmful wound. There is continuously debate between Rugby Union, Rugby League and the Australian Rules Football about the performance of the protective scrum cap in rugby whether it has ability to prevent head concussion or not. The debate also involves the dispute about the scrum cap design whether it can minimize the shallow of head injury or either its designed has capable to reduce the rate and harshness of neurological injuries. The usage of protective rugby headgear is widely used in Rugby Union such as in New Zealand and Wales and Rugby League meanwhile in Australian Rules Football there is little player that worn the scrum cap.

1.2 Problem Statement

Problem of statement are used to show about the relationship about the current issue in the rugby protective headgear study. The objectives and the scopes of this study are design to deal with those problems in rugby protective headgear. Some problem has been occurred were when there is the study that have conduct test to examine the level of impact energy attenuation by eight various type of commercially headgear product and have found that when the energy supply was impact at around 20 J [6], then the foam material becomes completely compress which is hence it not contribute to the protection for head to against more severity of impacts. So, they have concluded that the current available rugby headgear is not satisfactorily able to decrease or minimize the occurrence of head concussion. This mean, the rugby scrum cap cannot able to adapt the large amount of impact during collision. Subsequently, there is the dispute and argument about the wearing of rugby headgear either it can prevent head concussion or not. This is because of during the impact of collision. Then, the energy that absorbing by the scrum cap material accomplishes by compressing to absorb force during the collision and slowly returning to its original form. Later, the compression and restoration have those impact extending the duration of collision while dropping the full momentum transported to the head. However, it remains as question to how far the capability of the rugby headgear able to respond to lower impact collisions responsible for concussion. Afterwards, there is between a sixth and a third of all rugby injuries by the body region that has been reported which is the soft tissue injuries becomes the majority and head concussion is commonly as occurrence issued. Although, International Rugby Board (IRB) has conduct the laboratory tests and has approved that the standard rugby headgear has shown that the performance of impact force is unlikely to reduce the risk of concussions. In addition, the laboratory tests also have shown that the impact performance by the rugby scrum cap can be improve by increase the thickness and its density on the headgear foam. That earnings, effectiveness and efficiency of the standard padded may be limited.

1.3 Objective

- a) To conduct survey of current rugby headgear as safety attire for rugby players.
- b) To design the concept of rugby headgear considering the prevention of head concussion.
- c) To fabricate the prototype rugby headgear that can prevent head concussion for rugby games.

1.4 Scope of Study

- a) The survey will be conducted to gain the information from rugby coach and player on their opinion and knowledge about headgear from their view whether the current rugby headgear is able to prevent head concussion or not.
- b) To establish the rugby headgear that made from the chosen material that have suitable properties such as soft and durable material that capable to absorb vibration therefore preventing head concussion.
- c) To fabricate the appropriate rugby headgear which is comfortable and can increase the safety for the rugby player to protect against and minimize the risk of head concussion and injury during rugby games.

CHAPTER 2

LITERATURE REVIEW

2.0 Head Concussion

The American Neurology Academy has determined the concussions as a traumatic-induced change in mental status that may or may not be accompanied by loss of consciousness [8]. Meanwhile, Kelly JP (2000) has defined the concussion as the type of mild of traumatic brain injuries which is an alteration in mental status caused by biomechanical forces that may or may not produces unconsciousness [9]. The confusion and loss of memory is including in the hall marks of the concussion which is also called as amnesia. The signs and symptoms consist of confusion, amnesia, loss of consciousness, sensitivity to light or sound, headache, dizziness, nausea, instability, confusion, star vision, double vision, drowsiness, impact shock, slow response time, unclear conversation [10]. All these signs and symptom of concussion has been diagnosed by the physicians and researcher [4].

A person that experience the head concussion will lose consciousness or blank for a short time even though usually concussion may not affect in a loss of consciousness. They will become amnesia where a person not being able to remember events before or following the injury for a period is another sign of concussion. Symptoms of concussion generally split into four categories which is remembering or thinking, physical, emotional or mood and disturbance in sleep [11]. All these four symptoms respond such as difficulty remembering recent events even before or after concussions, a person will experience headaches or difficulty with bright light or loud noises, irritability, sadness, or nervousness and over sleeping or lack of sleeping than usual [11].

2.0.1 Effect of Head Concussion on Player Health

The symptom of concussion can be fully recovering within days, weeks or a few months [2]. However, it also can be last even longer for some people. A player should meet doctor as soon as possible if they feel something is not right or feeling confused. Some of these symptoms may be give the impression right away but others may not be observed for days or months after injury occur. Occasionally, player do not recognize or realize that they are in trouble. Although, most player with concussion recovering quickly and completely but the symptoms can last for a few days, weeks or longer for some people. In general, recovery time may be difference among adults' player and young player. For those who have experienced concussion in the past, they are also at-risk concussion again and it may take longer to recover again [2].

The complication of concussion may be dividing into two phase which is early complication and late complication [12]. In the early, the intracranial space occupying the lesion may be likely to damage the arteries and cerebral veins leading to epidural, subdural and intracerebral hematomas respectively from bleeding of these vessels [13]. Then, the second impact syndrome occur by diffuse cerebral swelling. It is a rare complication but also known as head injury and usually occur to young people [14]. The first reported in American football player who died after relatively minor head injury. Minor head injury was following by loss of brain ability to control blood flow while blood flow of cerebrum increases rapidly, and brain pressure increases without control which leads to heart failure and cardiorespiratory death. Next, impact convulsion can be occurred within 2 seconds of impact but not associated with structural brain damage. The absence of long-term cognitive impairment reflects benign nature [15]. For the late complication, there is a possibility that repeated head injury may occur that can cause chronic brain injury. There is a growing concern that head concussion may result in damage to the brain [16].

2.0.2 Injury of Head

Head injuries due to head-to-head or fall are primarily dispersed in combat and fight sports such as boxing, judo, karate, sumo, American football, rugby, ice hockey, and football and winter sports such as skiing and snowboarding. Head injuries related to sports are concussion which includes mild traumatic brain injuries [17]. The graph shows the number of primary, lower, and senior high school students aged 7-18 who had head-to-head sport-related injuries from 1998 to 2011. Judo was a major cause of death or severe morbidity between 88 athletes with head injuries, 40 joining judo.

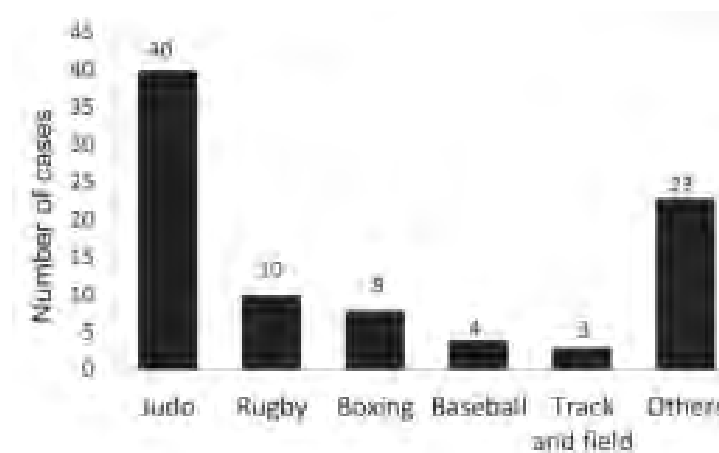


Figure 1.0: Catastrophic head injuries in Japanese students reported by the Japan Sports Council

(Source: Neurol Med Chir, 2014)

In 2002, The International Rugby Board (IRB) medical advisory committee was approved The Rugby World Cup 2003 injury surveillance project. [18]. All the teams that have joined the competition were required to participate in the injury surveillance project as part of the Participation Agreement in Rugby World Cup 2003. The injuries surveillance project was managed to monitor all the injuries that have occurred during each games of the tournament. It was handled by the tournament medical director. Major injury data is collected by team medical officer. All injury data such as player position, diagnosis and body area are recorded. Injury surveillance project was to study any injury or medical condition associated with a game event that would cause the player to leave the field during the game or miss the following game. [18]

The results showed that the head, neck and face were the most frequent body area with 25.6 to 41.7 injuries per 1000 hours of gameplay, followed by an ankles and legs from 8.7 to 19.2 per hour injuries of 1000 players, knees and thighs as shown in figure 1. Injury rate on head, face, and neck is more than twice the most frequent body birth rate, foot and ankle [18].

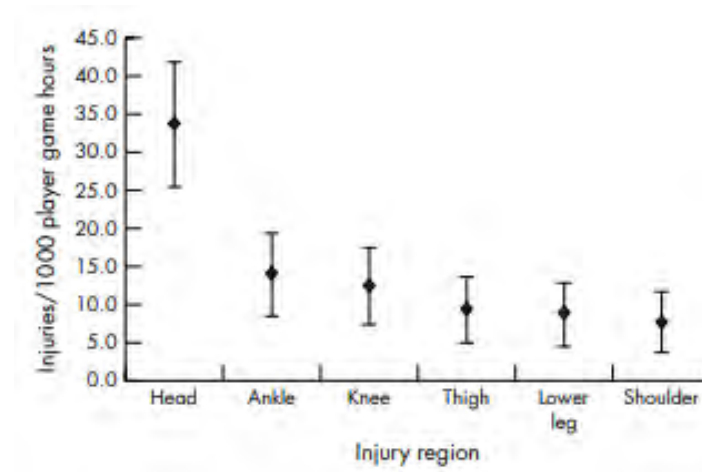


Figure 1.1: Rates of injury (all teams combined) and 95% confidence intervals for the most often injured body regions. Rates are expressed per 1000 player game hours

(Source: Rugby World Cup 2003 injury surveillance project, 2005)

As shown in the figure, the rate of injuries to head, face and neck injuries are twice as many as four other areas in five parts of injury. Such injuries are reported by Bathgate et al [19].

Y N Bird has described the injuries by player position [20]. As many 356 male and female rugby players have been followed up a prospective cohort study during the 1993 competitive club season. Interviewed by telephone method was used to get information about the amount of rugby played and injury they have knowledgeable in that period. The result come out with the forwards position had more injuries to the head and/or face and neck in games than in practices. The type of injuries usually involve is lacerations, concussion, haematomas and fractures. Injury and face game