

Predicting Medial Collateral Ligament Injuries Using Artificial Intelligence

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7/21/2022

Introduction

Artificial intelligence is considered to be the fourth industrial revolution. This cutting edge technology has helped us advance through improvements in various topics as well as aid in our everyday lives. An example you might see every day when you go through the traffic system is the AI being used to determine if you are following the traffic rules. You might be using artificial intelligence without even realizing it. Similarly, sports medicine has also been on the rise especially in the medical field. Sports medicine is by definition a branch of medicine that deals with physical fitness and the treatment and prevention of sports-related injuries and exercise. So now that we have an understanding of what sports medicine is, we can also see the importance of this field of study to athletes everywhere. Unfortunately, the use of AI in sports medicine has been very limited due to the lack of studies done to connect the two. In sports, one of the most common areas of injury is the knee, specifically the ligament in your knee known as the medial collateral ligament (MCL). Through the research on both the MCL and AI, I have hypothesized that it is possible for athletes and medical professionals who work with athletes to predict MCL injuries. Predicting MCL injuries could prevent long-term injuries for athletes and possibly prevent the need for athletes to miss games due to injuries.

Research Questions

The research question for this proposal is: How can AI-informed MRI images be used to prevent and diagnose MCL injuries in professional athletes?

Keywords: AI, MCL

Literature Review

The MCL is one of the four major ligaments in your knee and it is the ligament that helps support your knee and helps stabilize the rest of the body in your everyday movements like walking, running, getting up and down, etc. Knee injuries are very serious when it comes to almost every sport. According to the NBA, knee injuries take up 9% of basketball injuries and prevent an athlete from missing an average of 18.1% of their games. (Sports health, 2010) Approximately 18% of soccer injuries are knee-related (Sports medicine, 2020), and 12.7% of American football players suffered from knee injuries as well (Pritchett JW, 1982). Considering the number of athletes who play this sport across the world, the number who suffer from knee injuries is astronomical and 7.9% of all knee injuries are specifically related to the MCL (Elsvier, 2017).

The MCL, as stated before, helps stabilize the joint and is the “primary responder to valgus stress and a secondary restraint to rotational forces”(Physiopedia, 2022). Currently,, the way we diagnose an athlete or an injured individual with an MCL injury is by a physical exam and an MRI, which is where the AI comes in.

Artificial intelligence is the term used to describe machine intelligence. This contrasts with the inherent intellect of both humans and animals. Machines that use artificial intelligence are capable of learning, planning, thinking, and problem-solving. The imitation of human intelligence by machines is the most notable aspect of artificial intelligence. The world of technology and innovation is home to what is perhaps the fastest-growing development. In addition, a lot of specialists think AI could handle difficult problems and emergency scenarios.

According to a group of researchers led by presenter Dr. Lawrence Tanenbaum, “An artificial intelligence (AI) algorithm was able to enable spine MRI exams to be acquired as much

as 72% faster while improving image quality”. (Erik L . Ridley, 2021) This technology has promised to be adapted to predict and diagnose an MCL injury.

Now the tool which is going to be used to look at MCL imaging and diagnose MCL injuries is magnetic resonance imaging (MRI). Using a magnetic field and radio waves produced by a computer, MRI is a medical imaging procedure that produces precise images of your body's organs and tissues. Large, tube-shaped magnets are the common shape of MRI equipment. Your body's water molecules briefly realign when you are lying inside an MRI machine due to the magnetic field. These atoms are aligned, and the radio waves provide feeble signals from which cross-sectional MRI images are made. “Magnetic resonance imaging (MRI) of the knee uses a powerful magnetic field, radio waves, and a computer to produce detailed pictures of the structures within the knee joint. It is typically used to help diagnose or evaluate pain, weakness, swelling or bleeding in and around the joint”(Radiologyinfo, 2022).

Experimental Design

Objectives

The goal of this experiment is to use an AI algorithm based on working an MRI machine in order to determine and predict MCL injuries for athletes.

Methods

In order to assess the data and information we collect we need to collect MRI images which can be done in a hospital connected to the player or players club or the club's personal MRI machine. Currently dependent on the situation a typical professional athlete undergoes routine MRI imaging. For the purpose of this study, we will take a minimum of two separate times at which these images are taken, the first being “off” season which is presumably when no injuries are present as a control image, and an “on” season set of imaging which is when injuries are more likely to occur. Medical professionals have found when diagnosing an MCL injury an MRI can help to a certain limit but a clinical examination is heavily stressed to be done when going through the process. (Curues, 2018) Due to this, we will have a clinical examination done hands-on each set of times the imaging takes place. This process at first will be given to a select group of athletes more specifically certain clubs or professional sports that share an interest in the idea. Then once these groups are picked out the tests will be supplied to the majority of the athletes. The average athlete that is currently fitted with a presumably healthy knee and MCL will be used as the baseline for the team. The baseline for each group of athletes will be slightly different per group due to the different intensities and training regimens they go through. The collection of before and during and possibly also after images throughout the season will help us get an understanding of the load the MCL is taking before the injury so that the AI program can determine when an athlete is in the possibility of an MCL injury.

Limitations

Limitations could include price due to the relatively expensive prices of an MRI as well as considering the even higher price of an MRI worked by AI. AI also has the potential to reduce the number of personnel needed to diagnose an injury. Another limitation that could be a factor would be the number of these MRIs that would be needed to support athletes all over the world. Very unique limitation that would be more commonly found in professional athletes are the club's willingness to allow athletes to use this new technology as well as the number of times they would have to be going through this process for example, after every game, after every quarter of a season, after every season, etc.

Analysis

The data when taken by the MRI machine will be run through the the AI algorithm which is programmed to determine whether or not the MCL is in healthy condition. Whether or not the information was successfully used will also be added to the programming as it can be improved and more perfected with more testing.

Conclusion

As the field of AI spreads its roots through the different corners of the world the study of sports medicine has a bright future with the use of this technology. The athletes who currently go through the brutal process of injury and specifically the MCL injuries while may not be the most common injury are definitely one of the more severe injuries. This research would go towards these directed athletes and help their medical staff and/or personal analysis of their bodies to benefit them. The use of this futuristic technology is a clear way of fixing this issue and putting more players on the field as well as more competitive sports to be played and watched by fans around the world.

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