

Thesis Project Portfolio

Designing a Novel Double-Barreled Syringe Device for Ultrasound-Guided Musculoskeletal Injections

(Technical Report)

Improved Performance and Advancement of Player Safety in the National Football League

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Michael Ryan Burns

Spring, 2022

Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

Designing a Novel Double-Barreled Syringe Device for Ultrasound-Guided Musculoskeletal Injections

Improved Performance and Advancement of Player Safety in the National Football League

Prospectus

Sociotechnical Synthesis

Since the beginning of athletic competition, injury has closely accompanied. As sports and exercise have gained popularity, the prevalence of injuries has continued to rise. The approach to injury has been a twofold combination of mitigation and treatment measures. This thesis project approaches both avenues. The technical project focused on treatment by seeking development of a new medical device for use in ultrasound-guided musculoskeletal injections. These injections are commonly given in sports medicine cases where two separate medicines (ex. anesthetic and steroid) must be injected without mixing, all while continuing to hold the ultrasound scope for proper needle positioning. This process is uncomfortable for both the patient and physician, so the project focused on integrating this into a single device. In pursuit of a novel device, computer-aided design, 3D photopolymer resin printing, and a highly iterative design process were used. The result was a functional prototype that interfaced with syringes and needles on the market and used a modified stopcock mechanism to achieve disparate fluid injection. As a result, the specified aims were achieved and the prototype was able to gain substantial clinical approval. Further work on this project could focus on improved user comfort, excess material reduction, and the use of a more accurate production method for increased accuracy and repeatability. The sociotechnical research was an examination of how the balance between performance, or game enjoyability, and player safety has been approached in the National Football League. Player safety initiatives have become a focus for all athletic leagues, but due to the severity and prevalence of injury in American football the NFL has invested heavily in them. These initiatives have taken the form of rules changes, equipment improvements, and others, each of which have been met with different levels of social support. The analysis used the social construction of technology framework to analyze the role of

different social groups in informing the methods successfully implemented to increase player safety and how a balance between safety and enjoyment has been struck. While all parties agree player safety is important, their orientation on which methods are best to use vary dramatically. The outcome of this research was a better understanding of the way different social groups have impacted measures surrounding player safety in the NFL. Further research could explore the controversy over artificial turf more deeply, search for more effective ways of promoting advancements, or explore ethical issues concerning who is responsible for maintaining player safety. Overall, the technical and sociotechnical research explore different methods of assisting with injury in an effort to mitigate risk and decrease prevalence in the future.