

Undergraduate Thesis Prospectus

**A Specialized Scalpel for Use with the Seldinger Technique**

(technical research project in Biomedical Engineering)

**Conservativism in Sport: Opposition to Safety Regulations in Professional American Football**

(STS research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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**General Research Problem**

*How can occupational injuries be prevented?*

On average, occupational injuries reduce the lifespan of the victim by 3.5 years (Varacallo & Knoblauch, 2019). They range in severity, sometimes rendering employees unable to work or even causing death. The incidence of workplace injuries has declined in recent years, but accidents across all fields remain common (BLS, 2018). Decreasing the rate of occupational injuries even further will lead to longer life expectancy and better quality of life for America's workforce.

**A Specialized Scalpel for Use with the Seldinger Technique**

*How can patient and physician injuries during catheter insertion be minimized?*

Dr. Nishaki Mehta from the University of Virginia School of Medicine, Department of Cardiovascular Medicine, has called for a capstone team to design a scalpel, specialized for use with the Seldinger Technique. This single-person capstone team will continue the work of a previous group.

The Seldinger Technique is a common method for accessing blood vessels for catheter insertion. First, a hollow-point needle is inserted into the blood vessel. Then, a guidewire is fed through the needle into the body. Next, the needle is removed from around the guidewire, leaving a small hole at the insertion point (Seldinger, 1953). Because the catheter to be inserted has a larger diameter than the needle, the insertion hole must be widened with a scalpel. Making this cut is complicated by bleeding from the needle insertion site. The physician must make a blind cut through the blood, causing difficulty finding the incision point, accidental laceration of the blood vessel, or physician

injury from the scalpel blade. The new scalpel design will mitigate these dangers by offering blade depth control, guidewire-based blade guidance, and mechanical blade retraction.

This specialized scalpel design must include all of the features listed above, while maintaining the same general shape and size of a typical scalpel blade. It must be compatible with standard blades, and must not require additional training for physicians to use.

Standard disposable scalpels are currently the most used blade for the Seldinger technique. Options are available for retractable safety scalpels, such as the popular PenBlade (“Penblade | Safety Scapels,”). In addition, scalpels have been designed to include rails for guidewires, which could help lead the blade to the incision site (United States Patent No. US7341596B2, 2008). There are also models available which allow very fine depth control, often advertised for use with eye surgeries (European Union Patent No. EP0612506A3, 1994). Although specialized scalpels are available that can address most of the listed concerns individually, none have been designed specifically to fit the Seldinger technique.

The new scalpel design will combine the existing solutions into an all-in-one Seldinger specialized retractable blade. The blade will be fully retractable into the housing by turning a gear at the blade end of the handle. The physician can also use this gear to adjust the blade cutting depth. This gear can also be fixed in place once a depth is selected to prevent the blade from changing length during a cut. A narrow hole will run along the length of the handle, so that a guidewire running through the hole will exit the handle in line with the end of the blade. These mechanisms will lead the blade to cut to

the exact desired spot at a precise depth, while maintaining the simple shape and general dimensions of a typical disposable scalpel.

### **Conservatism in Sport: Opposition to Safety Regulations in Professional American Football**

*How do critics and advocates of safety regulations in American Football advance their agendas?*

Although injuries have occurred in football since its invention, they have become a subject of particular concern and controversy in the 21<sup>st</sup> century (Harrison, 2014). As research has poured out of universities around the country, the concern for player safety has left the future of thousands of employees, millions of fans, and an industry estimated to be worth over 10 billion dollars, hanging in the balance. As the National Football League (NFL) regulates gameplay in response to public outcry (NFL, 2019) some fans believe the century-old game they grew up watching is being changed for the worse (Estes, 2018).

Advocates and critics of reform have used internet blogging as a powerful method of sharing ideas and organizing opinions (Kian, 2011). As a platform on which anyone can share their opinion, internet blogging has given people a voice in controversies from any location, in real time. Comment sections encourage responses by the public, and support discussion.

The National Football League Players Association (NFLPA) is a union that represents the interests of NFL players in the NFL, including player safety. In a 2016 press release, the NFLPA claims to have “dedicated millions” of dollars to create the

Football Players Health Study at Harvard University“ (Johnson, 2016). The NFLPA also negotiates with the NFL on matters of player safety. The NFLPA can appoint two members of the NFL Competition Committee, which determines all rules changes, and can change rules believed to impact player safety through the Joint Committee for Player Safety and Welfare Arbitration (Deubert, et al.). According to its mission statement, the NFLPA values the rights of the player, and seeks to “preserve and enhance the democratic involvement of [their] members” in NFL proceedings.

The NFL is an American professional sports league in the business of American football. Researchers have linked disease in retired players to concussions incurred in gameplay (Guskiewicz et al., 2007). Under pressure, the NFL has improved player safety, including making an agreement with the NFLPA to “protect the health, safety, and wellness of NFL players” (NFL-NFLPA, 2019). The NFL’s main interest is viewership growth, especially of its premier championship game, the Super Bowl. Viewership growth determines the value of the NFL’s broadcasting rights, its largest revenue source (Burns, 2016). The factors most affecting NFL viewership include “closeness of contest,” regardless of perceived player safety (Carney & Fenn, 2004).

Fans disagree about the urgency of safety. Advocates of more regulation for safety believe that player well-being should be held paramount, and the game must adapt as necessary to ensure it (Foley, 2018). These fans often employ fear appeals in their arguments, claiming that watching NFL games is leading to the deaths of players (Gross, 2016). Fans who support increased safety regulation often cite medical research to pressure the NFL to make changes. These fans value player health over consistency of

gameplay, and have led the NFL to introduce controversial new rules, including the prohibition of initiating a tackle with the helmet (“Approved 2018 Playing Rules,” 2018).

Other fans perceive football is under attack, facing new regulations that will make football less exciting to watch at little benefit to player safety (Kurtzman, 2018). They claim that violence and danger are inherent aspects of the sport (Miller, 2018). They tend to be older men who have watched the game change through the 21<sup>st</sup> century, and who value the excitement of gameplay. By boycotting NFL games and limiting viewership, these fans hope to prevent further regulation from “softening” the game. So far, NFL viewership has continued to grow despite protests from this group (Jones, 2019).

U.S. news outlets have reported extensively on the NFL safety regulations controversy. News outlets ostensibly value bringing important stories into the public view. They seek high viewership, which creates revenue through advertising and donations. To increase viewership, stories related to NFL safety regulation may employ fear appeals for shock value. Stories often include accounts of player deaths, and have drawn additional controversy by asking whether children should be allowed to play contact football (BBC News, 2017; Larned, 2017). By publicizing the dangers of football, outlets have pressured the NFL to increase safety regulations.

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