

Thesis Project Portfolio

Development of a Mechanical Model of the Lumens of the Male Reproductive Tract

(Technical Research)

Barriers to Long-Term, Semi-Permanent Male Contraceptives and Male Involvement in Reproductive Health

(Sociotechnical Research)

An Undergraduate Thesis

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Olivia Luu
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Department of Biomedical Engineering

Table of Contents

Sociotechnical Synthesis

Development of a Mechanical Model of the Lumens of the Male Reproductive Tract

Barriers to Long-Term, Semi-Permanent Male Contraceptives and Male Involvement in Reproductive Health

Thesis Prospectus

Sociotechnical Synthesis

Introduction

Progestin-Only pills, intrauterine devices, and vaginal rings are common examples of modern long-term, semi-permanent contraceptives—for women. On the current open market, no semi-permanent devices exist for men. The first long-term contraceptive was created in 1953 that targets progesterone and estrogen (“A Brief History of Birth Control,” n.d.) in the female body. Since then, dozens of new long-acting contraceptives for women have been created. 70 years later, there is still yet to be a long-term, semi-permanent choice for men. Contraline, Inc., a biotechnology company in Charlottesville, VA, hopes to be the first to bring contraception of this type to market, similar to an intrauterine device, by inserting a hydrogel into the vas deferens, the pair of tubes that transport sperm, of the male reproductive tract. In order to perfect the device, Contraline, Inc. requires a viscoelastic model of the inner tract that dynamically responds to pressure and manipulation. My technical research will involve researching the structure, mechanics, and properties of the human vas deferens to develop a mechanical model to be used for future testing. My sociotechnical research will focus on the reasons that barriers of long-acting, reversible contraceptives for men as well as the barriers of the involvement of men in the uptake of contraceptives. With the potential of a new contraceptive, it is important to understand and evaluate the pushback of the last half century regarding male reproductive health.

Technical Research

The technical portion of my thesis aimed to produce a model of the male reproductive tract that mimicked the overall shape, mechanical properties, and structures of an actual human reproductive tract. The model was designed in Autodesk Fusion 360 and printed with Elastic

50A resin in a Formlabs Form 3 SLA resin printer. The aim of my technical research was to design the model from the start of the vas deferens (where it meets the epididymis) to the ejaculatory duct, including the ampulla, which lies between the two structures. Accurately depicting the structure required extensive research into the inner and outer diameters of the vas deferens, ampulla, and ejaculatory duct, as well as analyzing samples of human vas deferens taken from vasectomy procedures. After many iterations, we were able to produce a semi-working model of the reproductive tract, providing Conraline with the capability of performing continued, repeated experiments. Our research and work are significant, because it provides a model other than cadaver tissue and plastic tubing that can mimic the structure as well as the properties of the human male reproductive tract.

Sociotechnical Research

The sociotechnical portion of my thesis aimed to investigate the barriers to male contraceptives and male involvement in contraceptive uptake in the United States, but also worldwide using two ethical frameworks: cultural lag and technological momentum. In this research, I highlighted the disparity between male contraceptives on the market and female contraceptives, beginning with the history of both and analyzing the root causes of the lack of male contraceptives. Many male contraceptives fail to reach FDA approval due to the stigma surrounding emotional weakness and side effects such as depression, anxiety, and weight gain. I also researched the causes of male apathy toward reproductive health and found a gap in education for men regarding proper sexual and health practices. There is a lack in teaching for boys and young men in understanding their reproductive system and the importance of being involved. Men are also not involved in their own reproductive health as intensively as women due to the existence of assisted reproductive techniques which take the place of andrologists,

reproductive doctors for men. My research aims to understand these barriers and suggest ways to improve male involvement and bring male reproductive health into the spotlight.

Conclusion

Given the similar nature of both my technical and sociotechnical research, I was able to use what I learned in tandem to better understand the nature of male contraceptives and their novelty in the medical field. I learned where the disparity lies and the causes of them and how to better develop ways to combat these differences. Researching men and their situation made me more aware of the dependency on women to provide the knowledge on reproduction and contraception, fueling my drive to work toward a more equal future. This project has made me better comprehend Contraline's work and the possibility of a better tomorrow as well as the ethical impact a non-hormonal contraceptive can have on men, eliminating all manipulation of male hormones.

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