

Thesis Project Portfolio

Optimizing Procedural Delivery Methods for a Novel Male Contraceptive Implant

(Technical Report)

The Scientific Repercussions of *Roe v. Wade* and the Uneven Burden of Contraception in American Culture

(STS Research Paper)

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Sociotechnical Synthesis

Contraline is a local medical device start-up aimed at introducing a novel contraception option for men. Their proprietary hydrogel, ADAM™, is designed to physically occlude the vas deferens, the male reproductive duct responsible for the transport of sperm during ejaculation. Sperm cells blocked by the hydrogel barrier degrade naturally and, with time, are reabsorbed into the walls of the vessel. Further, at the end of its lifespan, the occlusive hydrogel liquifies, thus removing the barrier to sperm flow (“Contraline Product,” n.d.). However, precise cannulation of the narrow lumen – or internal channel of the vessel– remains a significant challenge to effective implementation of Contraline’s technology. Further, current models fail to mimic the distinct mechanical and physical properties of the sperm duct *in vivo* and, thus, oversimplify testing of the hydrogel delivery procedure. Without a realistic means of testing, Contraline has struggled to effectively correct procedural pain points.

With my technical project, I aim to address these challenges to implementation by (1) developing an anatomically-accurate *in vitro* model of the vas deferens and (2) designing and assessing delivery solutions to ensure accurate injection into the vessel lumen. To characterize the mechanical properties of the vas deferens, tensile testing was conducted using canine tissue samples. Vessel models were subsequently produced using the synthetic elastomer polydimethylsiloxane (PDMS); the composition of the elastomer material was tuned iteratively to match experimentally-derived values of tissue elasticity. In conjunction with model fabrication, a cannulation-assistive device was designed in AutoCAD and constructed using three-dimensional, extrusion-based methods. Upon application, the device is intended to improve convenience for practitioners, reduce time associated with hydrogel delivery, and ensure overall

accuracy of the procedure. Together, these improvements will aid Contraline in bringing the first long-term, readily-reversible, and non-hormonal male contraceptive option to market.

Contraline's hydrogel-based contraceptive represents a groundbreaking innovation in the landscape of male contraception, which has remained largely unchanged since the first human vasectomy was performed in 1897. More than a century later, male sterilization remains the only long-term male contraceptive method, accounting for only 2 percent of contraceptive practice worldwide. Meanwhile, female contraceptive methods – including female sterilization, intrauterine devices, contraceptive implants and injectables, hormonal birth control pills, and female condoms – dominate modern contraceptive practices, comprising 67 percent of global contraceptive use (United Nations, 2019).

These gendered disparities in modern contraceptive use have been further exacerbated by the recent strikedown of *Roe v. Wade*, a ruling which has threatened women's access to abortion services nationwide. Inspired by these modern challenges to reproductive freedom, my sociotechnical project examines the scientific repercussions of *Roe v. Wade* and the uneven burden of contraceptive responsibility in the United States. The gender biases inherent to the modern contraceptive landscape stem largely from the sexual revolution of the late 20th century, which saw a surge in female-centric contraceptive innovation following the introduction of the hormonal birth control pill in 1960 and the 1973 ruling in the case of *Roe v. Wade*; this period effectively liberated women from the expectation of motherhood while tying them inextricably to the responsibility of pregnancy prevention. Further, these disparities in reproductive politics extend beyond the category of gender. Women of color and low socioeconomic status face a disproportionate risk of negative reproductive outcomes as a result of systemic inequalities including limited access to educational and economic opportunities, low rates of insurance

coverage, and practitioner-level factors such as racial bias and stereotyping. Drawing on the principles of feminist critique and reproductive justice frameworks, I assess the modern repercussions of these entrenched inequalities by emphasizing the social, physical, and financial challenges faced predominantly by women in their efforts to prevent pregnancy. Further, I examine the ways in which these challenges are amplified in a post-Roe era.

The following portfolio offers a comprehensive assessment of contraception in the United States by analyzing both technological progress and ethical concerns. Both projects highlight the importance of redefining the socially-imposed gender norms surrounding contraceptive responsibility and pregnancy prevention. These initiatives are especially vital following the reversal of *Roe v. Wade*, a ruling which significantly transformed the conventional meaning of reproductive freedom in the United States.

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References

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