

Measuring Jaw Distraction Length via a Position-Aware Screwdriver
(Technical Report)

**A Virtue Ethics Analysis of Dr. Frances Kelsey and Her Role in the Thalidomide
Application Process**
(STS Research Paper)

An Undergraduate Thesis Portfolio

Presented to the Faculty of the
School of Engineering and Applied Science
University of Virginia, Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Biomedical Engineering

By

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May 14, 2021

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April 30, 2021

STS 4600

Socio-technical Synthesis: Distractor Osteogenesis and Its Connection to Thalidomide

My technical work and my STS research are connected primarily through the fact that they have significant implications on the health of children. My technical project is aimed towards children with craniofacial anomalies, and the implementation of our device to treat these anomalies will optimize patient treatments. My STS research analyzes the ethics behind Dr. Frances Kelsey, an individual who prevented thalidomide approval in the United States. While my technical project and STS research on thalidomide differ in how they affect children, both topics are tied by their effects on deformities in children.

My technical work aims to quantify distractor elongation in children who are born with craniofacial anomalies, specifically micrognathia (underdeveloped and recessed lower jaw) and retrognathia (deficient growth in the posterior jaw as viewed from the side profile). After a surgeon induces a fracture in the jaw, he/she attaches a distractor device and a user is able to utilize a screwdriver to elongate the distractor plates screwed into the jaw. This causes bone growth, which corrects the deformity. My team designed a displacement-aware screwdriver that allows for the conversion of angular displacement to translational displacement. Specifically, our screwdriver quantifies how far the plates of the distractor have been elongated so that parents/caregivers and physicians can know whether or not proper distraction/elongation is occurring.

My STS research centers around analyzing the ethics of Dr. Kelsey, who ultimately prevented the introduction of thalidomide in the United States. For context, thalidomide was

given to pregnant women to alleviate morning sickness, but was later found to cause severe birth defects in children including serious limb deformities. In my research, I utilized the framework of virtue ethics to formulate the claim that Kelsey possesses two classical cardinal virtues: prudence and courage. I was able to support this claim by demonstrating how the sub-virtues of practical wisdom, discernment, fortitude, and endurance are present within Kelsey's character. Furthermore, my analysis allows for a better understanding of the ethics and virtues behind individuals who hold authority to shape society with their decisions. The goal of my research is to facilitate a greater understanding of the morality of certain characters that can aid in the avoidance of tragedies such as the one caused by thalidomide.

Working on these two projects simultaneously allowed me to incorporate my technical perspective as an engineer and the social perspective I have gained throughout my STS research into each of the projects. When designing the screwdriver for quantifying distraction osteogenesis, I was able to broaden my knowledge of craniofacial anomalies and their physiological and psychological impacts on children. This gave me greater background knowledge for the effects of pediatric deformities, which allowed me to more thoroughly and accurately investigate the ethics behind Dr. Kelsey. My STS findings further emphasize the importance of proper research and testing in the biomedical field, which motivated me to incorporate the necessary design constraints and testing into our project and its future works. In summary, working on my technical project and my STS research in tandem facilitated the integration of two unique, important perspectives into each of the works to yield higher quality results/analysis.

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