Thesis Project Portfolio

Designing and Testing a Novel Custom 3D-Modeled Post-Operative Knee Brace
(Technical Topic)

The Influential Factors Embedded in Surgical Decision Making and Resulting Variation – An Analysis of Surgical Networks with Actor-Network Theory
(STS Research Paper)

An Undergraduate Thesis Portfolio

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The research involved in both the technical and STS projects focus on the surgical and rehabilitation industry. The surgical industry is growing rapidly due to innovative technologies, and increasing patient needs. An increase in osteoarthritis diagnosis, as well as incidence of ACL, PCL, and TKA injuries, drive the growth in the knee procedure industry. Multiple factors influence an effective post-operative recovery: the surgeon or specific procedure, financial or geographic feasibility, and the required medical devices. In the process of conducting preliminary research on industry standards and post-operative knee braces for the technical capstone project, I discovered multiple instances of variation in surgical decision-making processes. This prompted me to develop an STS research question surrounding the network of influence involved in surgical decisions and treatments.

With the demand for total knee replacement surgeries projected to grow by 673 percent to nearly 3.5 million operations by 2030, the need to properly rehabilitate patients after their operation is of high importance[2]. Typical rehabilitation works in stages, beginning with completely restricted movement and require patients to utilize multiple braces throughout the recovery process due to their varying capabilities. Our capstone project focuses on the development of a novel post-operative knee brace. This brace will be custom-fit to the patient and will have an adjustable range of motion throughout recovery and adaptable force redistribution intensity at the joint to unload forces on the tibia. Our brace hopes to address the shortcomings of current technology by allowing the patient to exercise their mobility at all stages with assistance from the brace, and foster better recovery of the knee joint following operation.

Surgery is an indispensable part of healthcare and unlike emergency procedures, elective surgery is conducted at the patient's discretion. The decision-making process looks different for each party involved: the patient, hospital providers (doctor or surgeon), as well as insurance or

financial provider. Further, there are a multitude of factors to consider when choosing to undergo surgery: rehabilitation time and requirements, severity of the issue or necessity of procedure, accessibility to facilities, adequate materials or technology, and financial burden. Under the framework of Actor-Network Theory, the STS research analyzes these actors and factors to investigate the key influences embedded within the network of surgery.

To adequate define variation in elective surgery diagnosis and decisions, I leveraged research regarding insurance standards, post-operative rehabilitation needs, as well as conducted an interview with a patient who recently decided to undergo elective surgery. While the technical project focuses primarily on device development, by focusing the STS research in the same industry, I was able to better understand current standards and industry requirements of rehabilitation to better uncover the network of influence.