Atraumatic Oral Retractor for Trans-Oral Robotic Surgery

Overview
Trans-Oral Robotic Surgery (TORS) is a relatively new procedure, designed to remove harmful tumors from the mouth and throat. One key aspect of the surgery is to retract enough tissue in the throat, creating an open passage for the robotic arms to reach the operating area. The Atraumatic Oral Retractor Group was tasked with upgrading current oral retractors to avoid unwanted side-effects like chipped teeth, tissue damage, and excessive pressure.

Objectives
Our design is a two-part functional model. The first part is a spring-loaded flapjack prototype is constructed using SolidWorks by modifying it to fit the patient's mouth and throat. The bottom surface of the first Mouthjack extends to the back of the throat with a magnetic track that assists in lowering the second Mouthjack closer to the operation site and prevents tongue prolapse. The second portion of the design is the silicon Flex-Sleeve Inflatable Ring that would be anchored on the robotic arm; it would then be able to slide over the head of the Flex-Robot. There are two designs explored: one with a dual-Mouthjack, one with a Mouthjack/Flex-Sleeve Inflatable Ring combination.

Approach
- Customer needs were gathered through a meeting with the project sponsor, an anesthesiologist, and the principal surgeon at Hershey Medical Center.
- Weighted hierarchal customer needs were compiled for design considerations before drafting them.
- The external research was done in order not to infringe on any existing intellectual property.
- QFD was done to evaluate the relationships between the customer needs and functional requirements.
- Concepts were generated and the best design was selected using Pugh Concept Scoring Matrix.
- Selected concepts were presented to the sponsor before moving forward with prototyping.
- Mouthjack prototype was constructed using SolidWorks and 3D printed.
- Flex-Sleeve was manually constructed using silicone and latex materials via an adhesive.
- Multiple prototype was made through trial and error before sending out for manufacture.
- FEM analysis were done for Mouthjack: Von Mises, Principal Stress I, Fatigue, and Factor of Safety.
- Mouthjack prototype was finalized and send out for manufactured.
- Testing was done at Hershey Medical Center.

Outcomes
- The proof of concept for the Flex-Sleeve Inflatable Ring was satisfied, however testing was withheld due to equipment expense
- Mouthjack was deemed practical, but material selected did not provide a rigid enough structure.
- Mouthjack will need a taper along the bottom portion; this taper will allow for the Mouthjack to extend further into the throat.