Summary (midterm fall)

In an attempt to develop an effective and robust micro pituitary rongeur, efforts have been made to design an innovative concept capable of performing all the necessary functions found in the current tool design. The rongeur's overall function is to remove unwanted tissue material from a body cavity. The user (surgeon) inputs a force which is transmitted from the user's hand to the tip of the tool 20-50 cm away. The tool must be able to contact and encapsulate unwanted material to be removed from the patient's body. Up to this point, the team has developed an innovative concept, "Howell's Design," as well as redesigned the existing tool to increase rigidity within the shaft as well as the jaws. Three different handle styles have also been developed. In addition to the existing handle style, a full hand grip has been modeled providing increased control at the tool tip. A modification of the existing scissor handle style was also modeled which increased ergonomics with a more natural hand grip. The third new style was designed to provide the user with variability during surgery. This design allows the user to operate the tool at different angles as well as upside down. All three handles are capable of being incorporated with the innovative shaft design as well as the redesign of the current tool. The redesigned shaft is composed of an upper section and a lower section. The upper section of the shaft is connected to the bottom by dovetail geometry. The upper section translates back and forth as the trigger is squeezed by the user. The continuous dovetail is a significant improvement to the current tool as it removes the stress concentrators in the original design and provides ample resistance to moment and buckling. The preliminary design steps are further explained in the succeeding sections.

Summary (Fall Final)

In an attempt to develop an effective and robust micro pituitary rongeur, efforts have been made to design an innovative concept capable of performing all the necessary functions found in the current tool design. The rongeur's overall function is to remove unwanted tissue material from a body cavity. The user (surgeon) inputs a force which is transmitted from the user's hand to the tip of the tool 20-50 cm away. The tool must be able to contact and encapsulate unwanted material to be removed from the patient's body. Up to this point, the team has developed multiple ideas for handles, shafts, and tips. The "Channel" Rongeur and the "Gator" Rongeur are the two redesigned concepts, each with different combinations and potential fixes for the shortcomings identified from the old tool.The Gator Rongeur shaft is composed of an upper section and a lower section. The upper section of the shaft is connected to the bottom by a dovetail geometry. The upper section translates parallel to the lower section as it is actuated by a trigger mechanism. The continuous dovetail is a significant improvement to the current tool , as it removes the stress concentrating holes found in the original design, and it provides ample resistance to moment and buckling. The Channel Rongeur incorporates a lower shaft seated within an outer, "U" shaped upper shaft. This design reduces the amount of needed pin locations which decreases areas of stress concentrations. The Channel Rongeur provides a simple design very capable of being manufactured at a reasonable price. Two unique handle styles have also been developed in addition to the existing handle style. A full hand grip design has been modeled providing more control at the tool tip. A modification of the existing scissor handle style called the "Honeycomb Handle" was also modeled which greatly increased capabilities. This design allows the user to operate the tool at different angles as well as upside down. All three handles are capable of being incorporated with the Channel Rongeur design as well as Gator Rongeur design. Stress analyses of the shafts and jaws have been executed using ANSYS and SolidWorks. Results were gathered and maximum allowable loads are compared graphically.

Summary (Spring Final)

The progression of the micro pituitary rongeur named the “Gator Jaw” has developed from the design to the manufacturing stage. This report includes the process taken in order to successfully prototype a working Gator Jaw rongeur. Slight changes have been made to part models within the tool assembly and are discussed acutely in the first chapter. No significant geometry changes occurred from what was described in the final report of fall 2012, therefore no additional testing has been required. After finalizing the 3-D models (along with all necessary pins required) thorough part drafts were generated which could be sent to a manufacturer in order to be prototyped. Each part within the overall assembly was drafted and revised by the group. Appropriate tolerances were implemented within the assembly to ensure the prototype would function smoothly excluding excess friction between interfaces. Each part draft was thoroughly inspected and revised by the team in an efficient and legible manner to prevent tolerance stack-ups and double dimensioning. Due to the small size of the part, advice was taken by Dr. Branson and Dr. Beale in a drawing review meeting where each part was analyzed and the manufacturing process was discussed. After the completion of part geometries, component materials and finishes were selected and specified within each draft. After finalizing the part drawings, micro-machining manufacturers were contacted requesting a prototyping quote. Engineered Medical Systems from Memphis, TN agreed to provide a working prototype at the lowest cost. An exploded view with corresponding bill of materials was then generated and provided to the manufacturer along with assembly instructions. Areas of possible patentability lie in the handle and jaw designs. The T-slot, which allows the shaft to transmit translational motion, has been incorporated into several other already patented rongeurs and therefore will not be an interest in the patent process. The handle design is one which requires a “point and shoot” method, much like a gun. While the method is similar, the features of the handle are not identical to a common gun. Instead of a protruding handle that requires a hand to wrap around and grip at the same time, the designed handle is one of two different physical features: the palm stop and the stabilizing rings. Together they spread the hand out, so as to reduce hand fatigue. Separately, the rear support serves as a resting stop for the palm while the rings allow complete tool stabilization independent of jaw actuation. The two rings also allow for various finger configurations. These two physical features, however, do not actuate the jaws; neither palm stop nor stabilizing rings move. Actuation occurs by force input to the trigger. This report thoroughly analyzes the prototyping process of the final Gator Rongeur design while discussing the possibilities of patents are various aspects the completed tool.