

Smooth Sanding Device For Arthroscopic Surgeries

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Objective

The objective of this project to complete development of a previously constructed arthroscopic bone and cartilage shaver for the following:

- Allow for appropriate sanding of bone and cartilage surfaces via approximation of a random orbital sanding motion
- To strengthen the device and provide a robust tool for manufacturing and testing

Background

- Osteoarthritis (OA) is a characteristic roughening of the joint, causing frictional pain that can be chronic
- ~750k knee arthroscopies occur annually in US for OA pain mitigation, and often require excision of damaged tissue
- Commonly used arthroscopic shaver heads often leave grooves in the areas that have been shaved as a result of tissue resection. This further irritates joint tissues and leads to a longer rehabilitation periods

Value Proposition

- Currently, no technology exists to re-shape damaged joint surfaces, which could lower patient rehabilitation times
- This device aims to create a random-orbital sanding platform for OA arthroscopic surgeries to improve patient outcomes
 - Allow reshaping of bone and cartilage to treat OA pain via smoothing cratered surfaces
 - Incorporate inexpensive, reusable tooltips to reduce patient costs

Key Requirements

- Variable output speed from 900-6000 RPM
- Random orbital sanding
- Hypoallergenic, replaceable tooltips
- Output shaft- 5mm diameter
- Modular tooltips, different grits
- Reliable 2-hour intermittent battery life with modular power supply
- Reusable device with reusable tooltips capable of sterilization

Concept Development and Theoretical Modeling

- Two initial designs: Sawzall DC motor and linear actuator, fixed DC motor with linear solenoids
- Reliability concerns directed to second option
- Preliminary testing with first prototype yielded approved results
- Completed circuit and coding
- Inner mechanism machined
- 3D Printed most remaining parts
- Awaiting MarkForged Printer for final handle

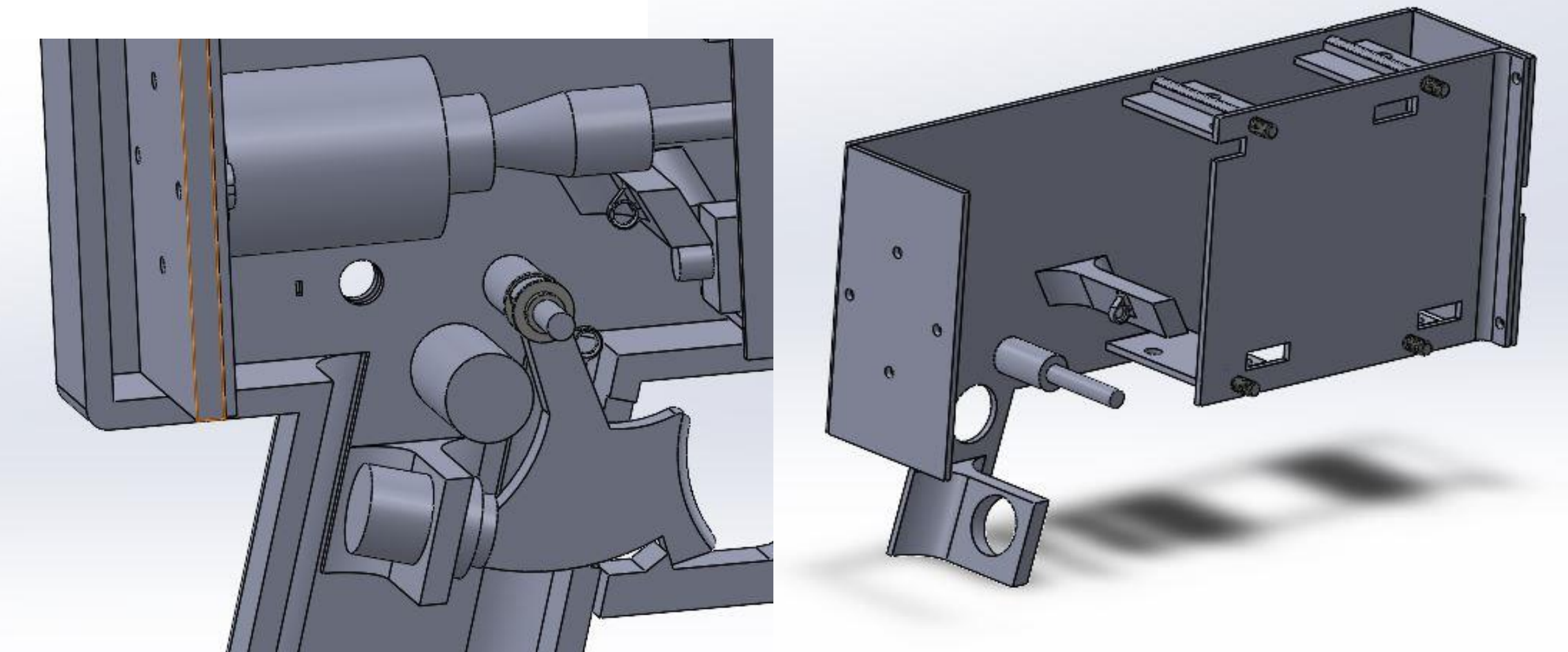
Final Design and Manufacturing

- Design functions with DC motor mounted linearly to the rotating shaft, conjunctive to 4 micro solenoids working in tandem to create linear actuation
- Achieves linear and rotational motion
- Potentiometer controls revolutions, toggle to activate
- Cylindrical rounded shaving head
- Final Prototype
 - MarkForged Printer for final handle

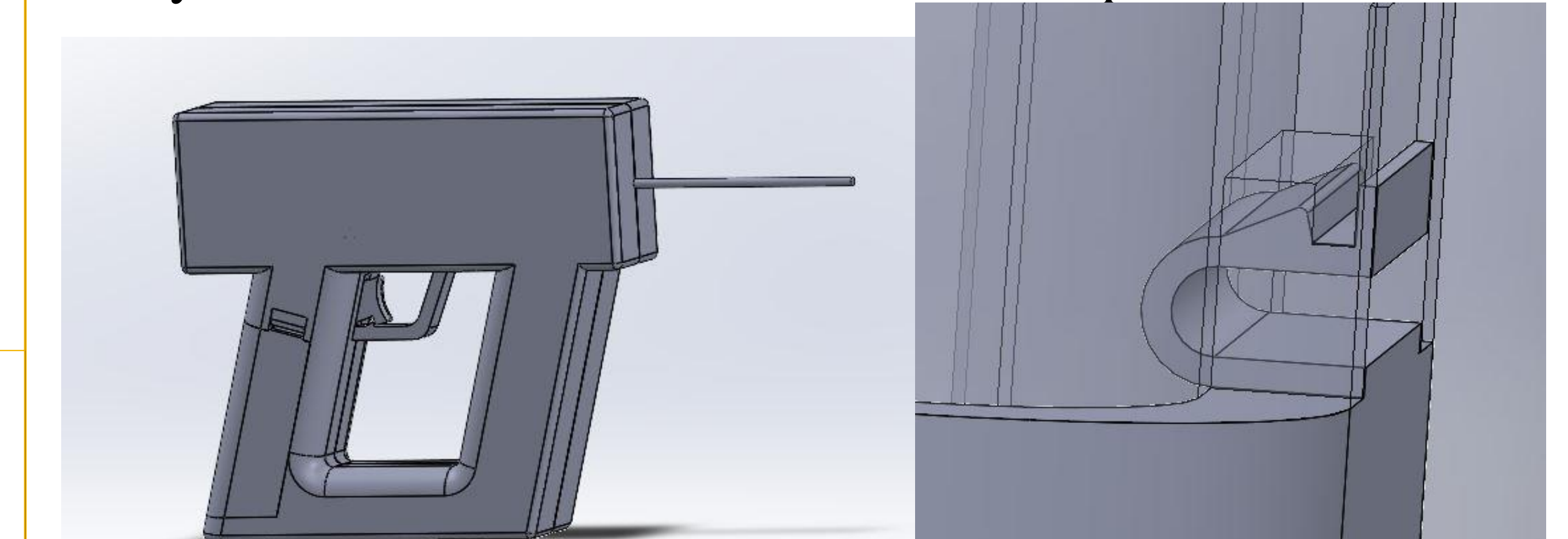
Validation

- Testing different tooltips against cow and pig thigh bones from Vandal Meats

CAD Modeling



- As you can see the parts withing the handle are close together yet have a little wiggle room
- Added a wall for the other side of the solenoids to prevent any unwanted rotation from the solenoid platforms



Project Management

- \$800 spent with \$700 remaining
- Large percentage going towards 3D printing

With 3D printing nearing completion next steps will be:

- Check to see if any components need to be repositioned
- Testing shaver in porcine and bovine models
- Ensure that no unwanted grooves are left behind
- Compare performance of shaver with current technology on the market
- Performing final tests to ensure shaft stays perfectly steady in use

Acknowledgements

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Oscillating Spiral 1/pi Ratio After 36 Rotations

