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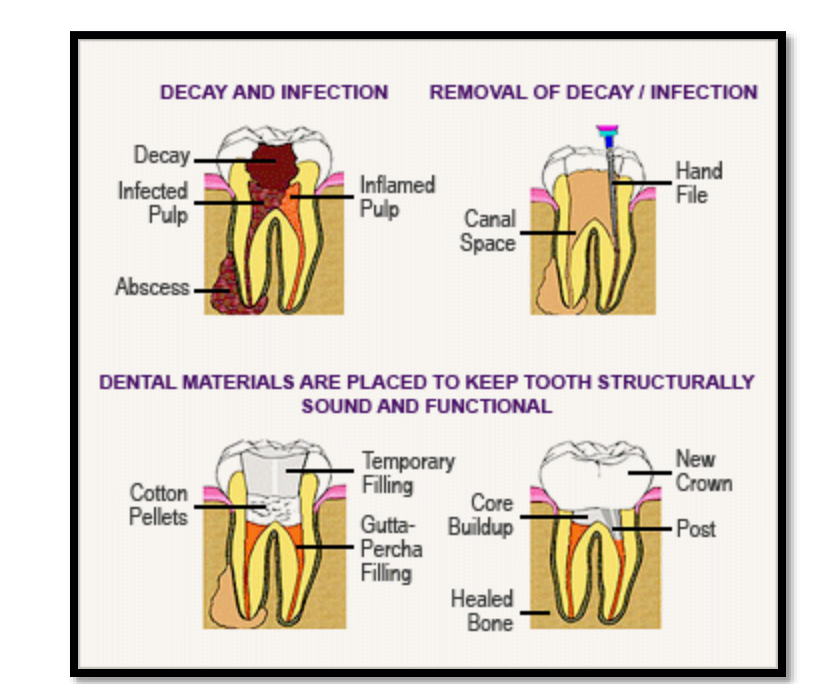
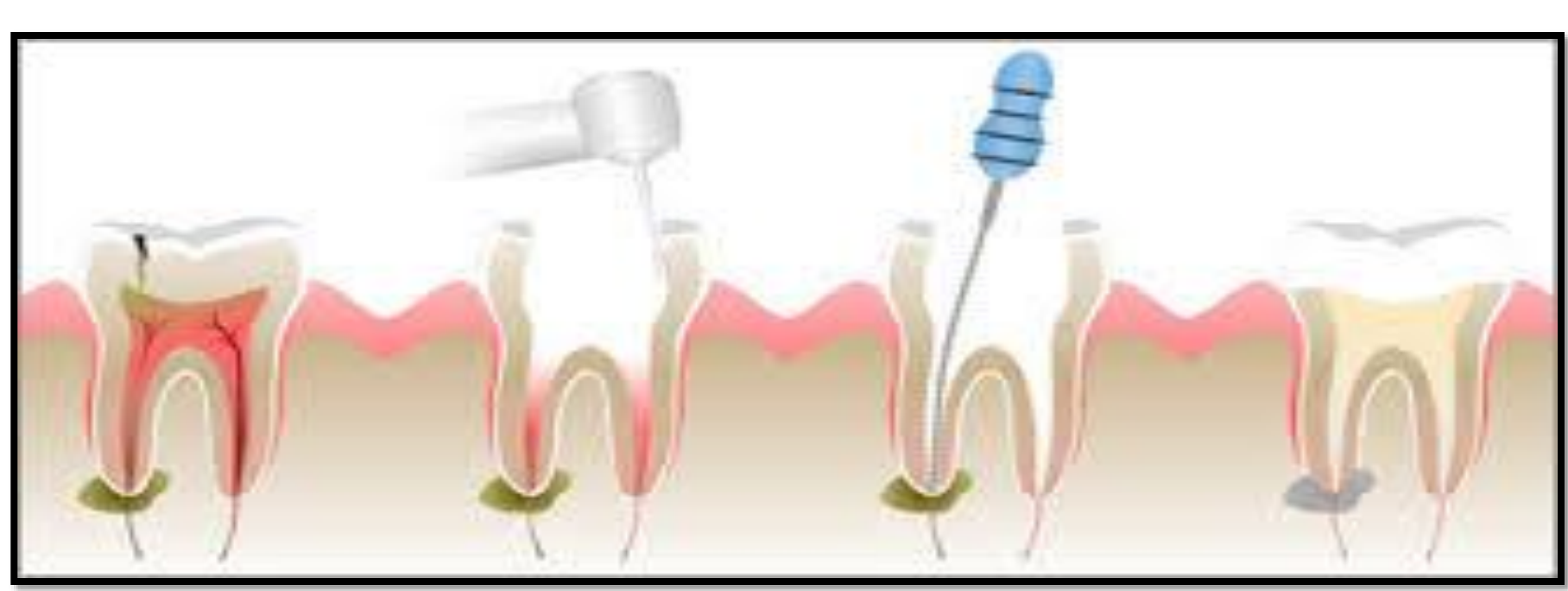
Device to Deliver Endodontic Material for Temporary Dental Fillings



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Clinical Collaborator:
 Virginia N. East, D.D.S.

Background and Objectives

Root canal therapy, performed over 15 million times just in the United States, requires patients to be treated over several visits to clean and shape the dental pulp chamber followed by the restoration of the tooth crown. Cotton wool is used extensively as part of the temporary fillings to preserve the space and integrity of the pulp chamber. In addition, cotton wool prevents the blockage of the root canals between treatment appointments. Statistically, 62% of general dental practitioners and 80% of endodontists use cotton wool as a spacing agent. Despite its ease application and affordability, fibrous remnants of the cotton wool can remain in the pulp chamber or become incorporated into the temporary filling. These remnants can lead to micro-leakage and subsequent bacterial colonization of the cotton fibers, ultimately leading to infection. Yearly, there are close to 500,000 post-operative complications due to cotton wool infections.



It has been proposed that materials like gelatin capsules or silica gels can function as temporary endodontic filling materials, replacing cotton wool in root canal therapy. In principle, these spherical materials would create a barrier for entry into the root canals while conferring mechanical stability to the temporary filling. Additionally, these materials could be functionalized to deliver therapeutics such as antibiotics or anti-inflammatory agents.

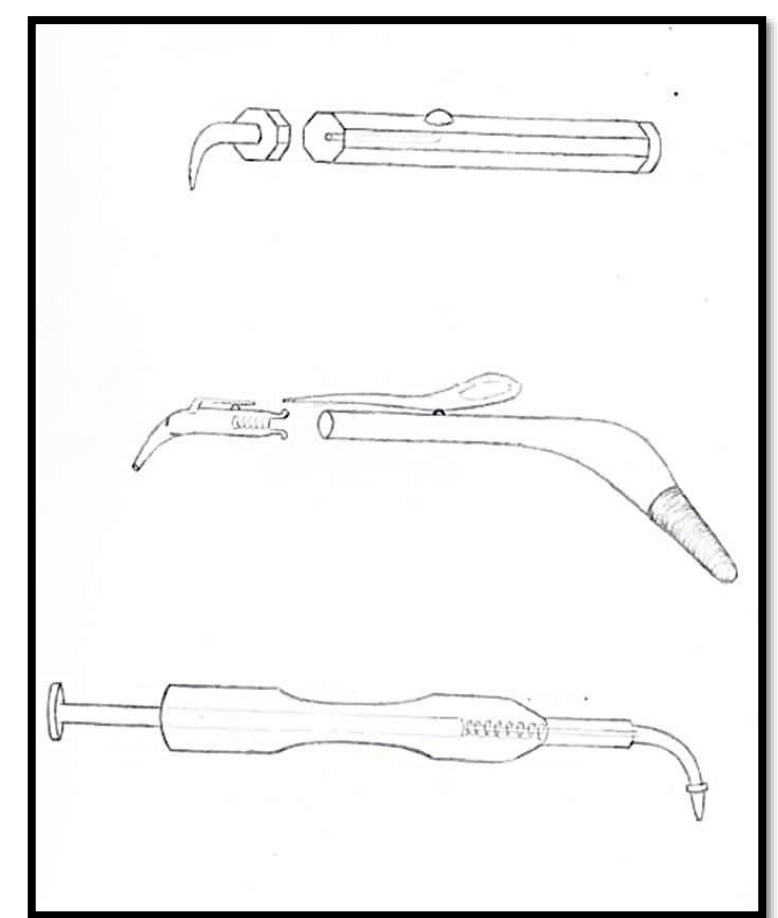
There is a **need for a reliable, functional, and clinically relevant delivery device** in order to catalyze the use of these new endodontic materials during root canal therapy. Here, we **propose the design of a new endodontic material delivery device to dispense alternative temporary filling materials that can eliminate the use of cotton as temporary material.**

Performance/Scale-Up

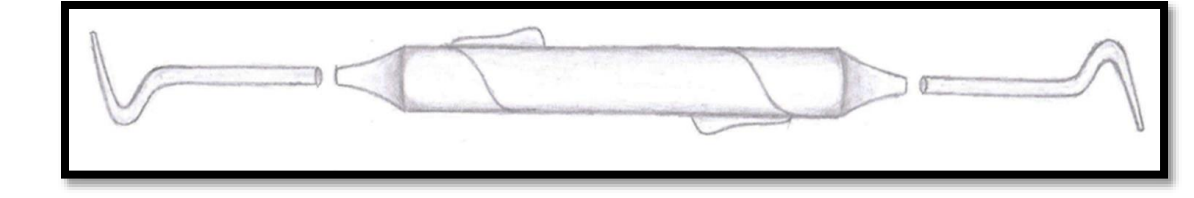
Operational Evaluation	Ergonomic Evaluation	Scale-Up
<ul style="list-style-type: none"> Accuracy Precision Rate of Malfunction 	<ul style="list-style-type: none"> Feel Comfort Ease of Use User Interface 	<ul style="list-style-type: none"> Market Prototype Detailed Market Analysis Researching Manufacturing Practices

Design Approach

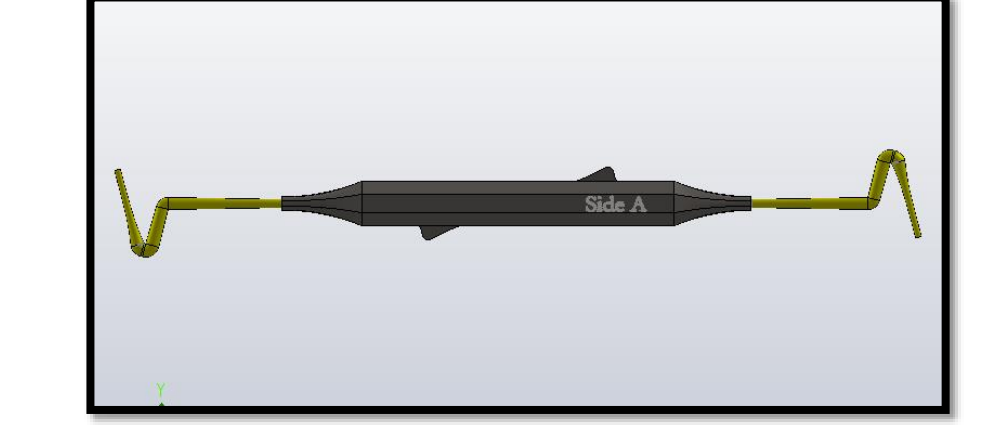
Initial Concepts



Directed Design

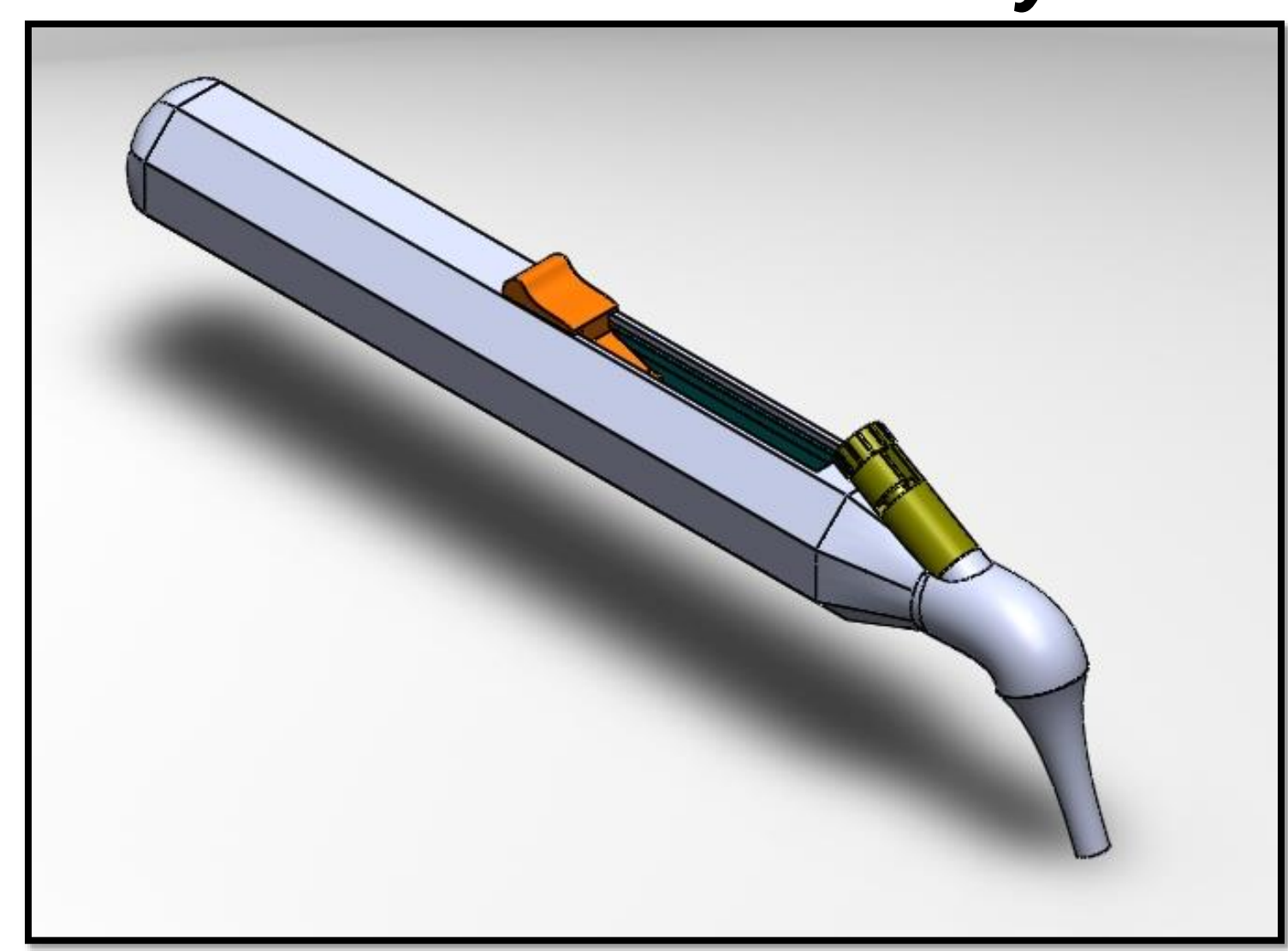


Preliminary 3D Model

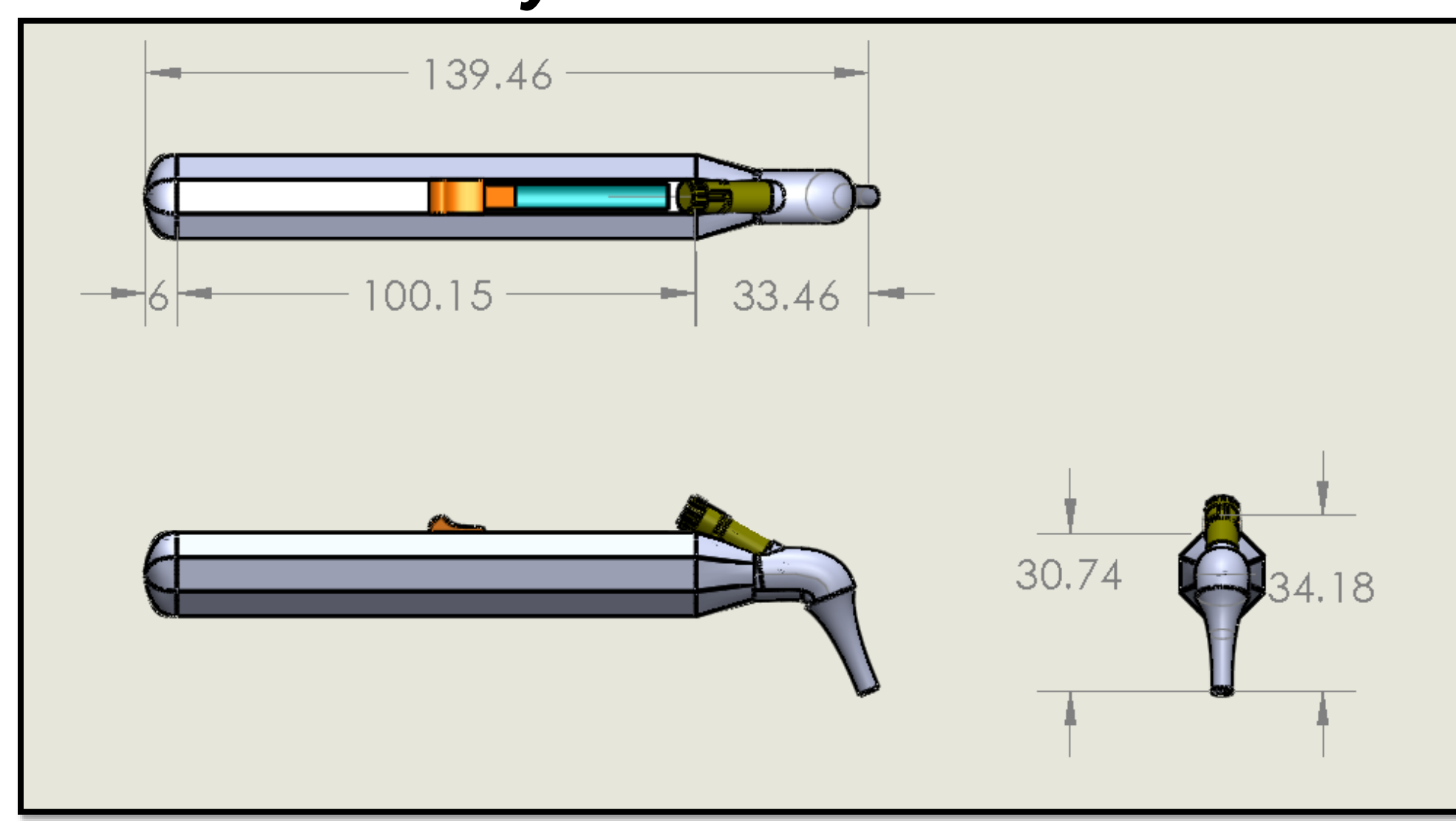


Final Design

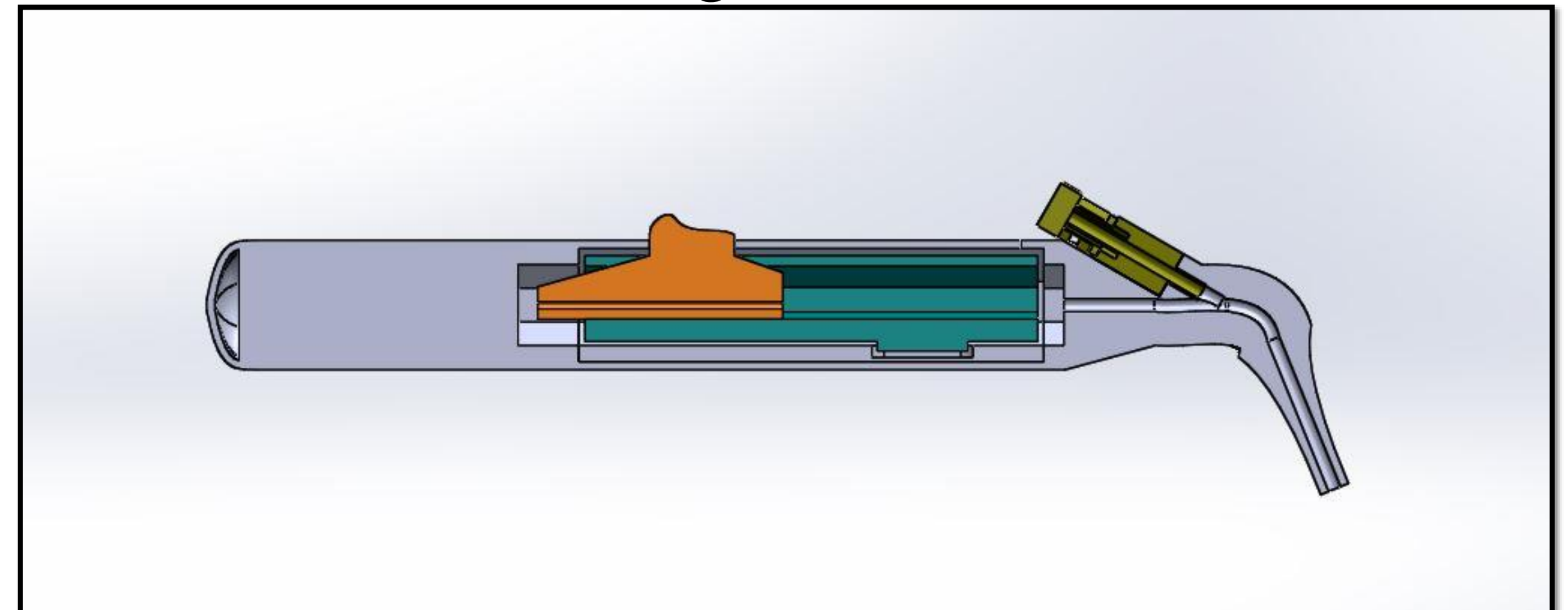
Full Model Assembly



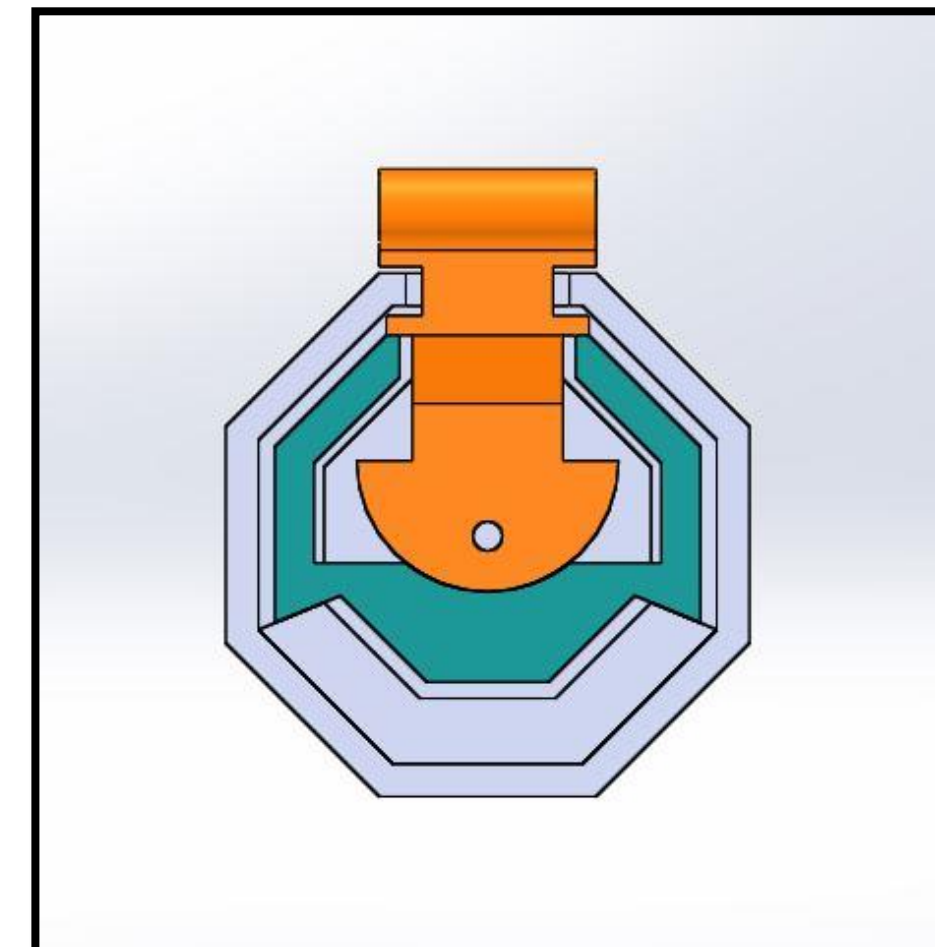
Three-Way View & Dimensions



Mid-Sagittal Section

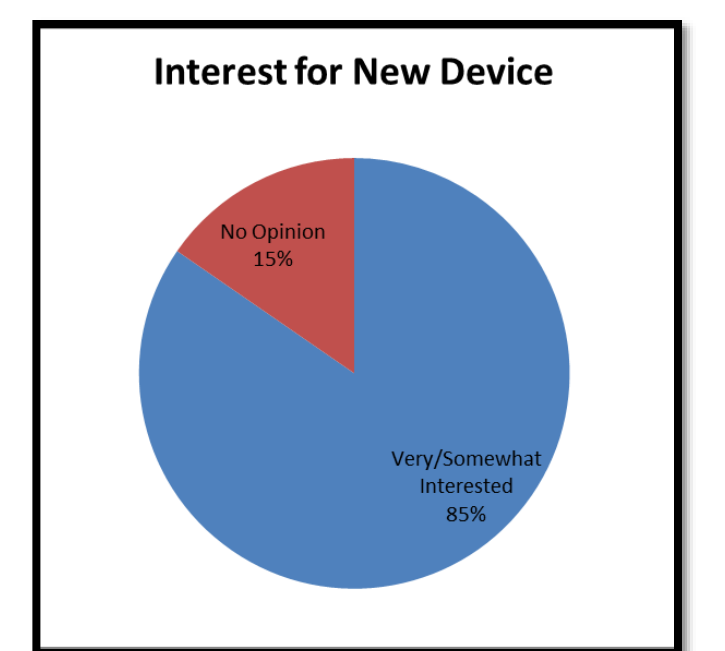
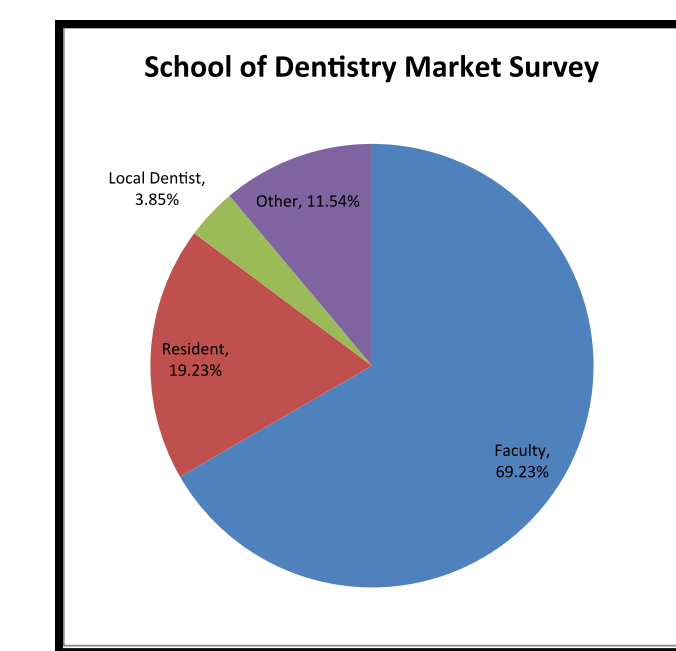


Cross Section



Design Considerations

In designing this device, we aimed to address specific concerns and adhere to certain limits in order for it to be as compatible as possible simultaneously with both user and patient. The design's characteristics were derived from various considerations such as maneuverability within the oral cavity, ergonomics and anthropometry, user interface, sterility, safety and misuse hazards, manufacturing processes, and complexity. Additionally, we wanted our product to meet the needs of our target population, predominantly dentists, therefore certain aspects of the design were tailored according to feedback gathered from a survey (n=26) sent to dentists, faculty, and residents within the VCU School of Dentistry



Conclusions and Impact

The potential for adoption and dispersion of this innovation is immense, both in the United States and globally. If the proposed device is implemented in dental clinics around the world, it would be greatly improving an iconic, well-known dental procedure for patients and would allow for greater quality of temporary tooth restorations. Upon optimization and manufacturing of this device, we will target dental schools and young practitioners to put our product in the hands of the future generations. This will allow them to familiarize themselves with new instrumentation and move away from old, problematic techniques. This device will catalyze a new direction for root canal therapies, yielding benefits for both practitioners and patients.

Acknowledgements

We would like to thank our advisor, Dr. Rene Olivares-Navarrete, and our clinical collaborator, Dr. Virginia East, for their support and guidance, and the Biomedical Engineering Department at Virginia Commonwealth University for generously funding our project and initiatives.