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Device to Deliver Endodontic Material for Temporary Dental Fillings

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Device to Deliver Endodontic Material for Temporary Dental Fillings

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 of 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 voids 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.

Operational Evaluation
- Accuracy
- Precision
- Rate of Malfunction

Ergonomic Evaluation
- Feel
- Comfort
- Ease of Use
- User Interface

Scale-Up
- Market Prototypes
- 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

Performance/Scale-Up

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.

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