

Dental Handpiece Scope

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Function:

The dental handpiece scope should consist of some optical device with the ability to take visual information from the operation site in a dental crown replacement, and project it onto a screen for the dentist to view, while being attached to the dental handpiece. This visual aide should be detailed enough to assist the dentist in completing the procedure with full view of the operation site, increasing the overall safety and efficiency of the technique.

Problem Statement:

During crown implant procedures, dentists are often confronted with difficulties viewing the teeth of interest. They may observe the location of the operation site and the hand piece with a mirror, but depending on the size of the patient's mouth and the location of the teeth, viewing can be nearly impossible, forcing the dentist to rely on intuition to complete the procedure. A camera capable of showing a live video feed of the operation site could remove this difficulty, allowing dentists to operate without the risks associated with blind handpiece use.

Client requirements:

- Create a small uninvasive camera to mount on top of a dental, drilling handpiece in order to make obscured teeth visible.
- The main focus of the project is to create a functioning camera mounted on the dental drill.
- The device can be made of hard plastic, or stainless steel.
- The camera needs to be able to project a live video feed onto a TV screen.
- The camera and surrounding equipment needs to be able to be put into a human mouth without causing harm to the patient or the camera.
- The camera needs to be able to see through water mists and splashes coming off the teeth.
- The camera will need to be waterproof.
- If initial design prototypes prove to be successful, the client would like us to integrate wiring directly into the dental handpiece rather than down the side.

Design requirements:

1. *Physical and Operational Characteristics*
 - a. Performance requirements:

- The dental scope must be able to have adequate spatial resolution to capture details of the tooth.
- Must be able to differentiate between the white/grey enamel and yellow dentin of the tooth.
- The chassis must be able to fit on the drill with a minimal size profile.

b. Safety:

- The electronics should not cause electrical shock to the user or patient.
- The device should not have sharp/rough edges that cause unnecessary damage to surrounding gums or soft tissue.
- The device should not dissociate inside the patient's mouth
- The dental scope must be sanitizable to prevent bacterial growth.

c. Accuracy and Reliability:

- The dental scope must be able to accurately provide a view of the desired location on the patient's tooth.
- There should be no or minimal latency of the device.
- The camera must be able to have an accurate autofocus to maintain a clear image of the tooth.

d. Life in Service:

- The device must maintain its structure and function over many daily uses.
- The device must last at least 10 years (average is 15 years).
- The electronic systems must be resilient for repeated use without breakdown.
- The device should work reliably during normal use for the same period of time as the drill it is attached to.

e. Operating Environment:

- The camera and electronics must be waterproof to withstand the saliva, pieces of food and water jet during drilling.
- All components must withstand the vibrations from the drill.
- The camera attachment mechanism must be sturdy enough to survive bumps and jolts without shattering.

f. Ergonomics:

- The camera must not add too much weight to the dental drill handle to avoid reducing the drill's ease of use.
- The camera must interface securely and minimally with the dental drill to ensure waterproof characteristic and reduce the external profile of the camera apparatus.
- The housing of the camera must not cause discomfort or injury to the patients.

- The camera must be fixed rigidly with the drill to prevent disassembling of the camera.
- The shell for the wire that powers the camera must not make the drill hard to handle.

g. Size:

- The camera needs to be able to fit on top of the drilling handpiece without being too bulky as to interfere with the dentists' ability to drill the tooth. 5x5 mm.

h. Weight:

- The camera apparatus needs to be light enough so as to not offset the weight and balance of the drill a considerable amount. 2-3 ounces.

i. Materials:

- Glass and stainless steel/plastic for the camera apparatus.
- Hard plastic for the housing of the camera.

j. Aesthetics, Appearance, and Finish:

- Skin safe coating and material for use inside the mouth.
- The apparatus should not visually present itself in a way that could cause discomfort to patients. It should integrate nicely with the design of the dental handpiece and not stand out.

2. *Production Characteristics*

- a. Quantity: 1 (prototype).
- b. The total cost of the device should be less than \$250.

3. *Miscellaneous*

a. Standards and Specifications:

- No international or national standards need to be met while the device is in the prototype phase of the design process.

b. Customer:

- Customers (practicing dentists) would desire a camera with a minimal external profile to reduce the amount of additional space required to use the drill in a patient's mouth. They would also want the camera to be waterproof and water-repellant to ensure circuitry security and unimpeded view.

c. Patient-related concerns:

- The device must be sterilized between uses (separately from the dental drill) and must be stored in the standard dental drill holder connected to the dentist's chair.

- Material of the device doesn't cause an allergic reaction in the mouth.

d. Competition:

- Dental drill integral camera and optics (US5049070A).
- Handpiece with built-in camera and dental treatment method using said handpiece (EP2891467A1).
- Electronic video dental camera (US5251025A).
- Imaging device for dental instruments and methods for intra-oral viewing (US20120040305A1).
- Video dental medical instrument (US5634790A).
- Dental handpiece with observational function (JPH0956730A).