Advances in Calculus Detection and Removal Technologies- A Review

* Dr. B. M. Bhusari ** Dr. Pradeep J. Chitnis *** Dr. Kunal A. Banavali

* Professor & Head of the Department, Department of Periodontics & Oral Implantology, Yerala Medical Trust’s Dental College & Hospital Kharghar, Navi Mumbai.

** Professor & Guide, Department of Periodontics & Oral Implantology, Yerala Medical Trust’s Dental College & Hospital Kharghar, Navi Mumbai.

*** Post Graduate Student, Department of Periodontics & Oral Implantology, Yerala Medical Trust’s Dental College & Hospital Kharghar, Navi Mumbai.

ABSTRACT

The essential component of conventional periodontal therapy is the effective removal of bacterial deposits from the root surface, along with calculus deposits, in order to create a biologically compatible root surface. Subgingival root debridement currently comprises the systematic treatment of all diseased root surfaces using hand and or ultrasonic instruments, until the root surface feels smooth and clean. However, traditional tactile perception of the subgingival environment without visible access before and after treatment frequently lacks sensitivity, specificity and reproducibility, and thus may lead to the unwanted removal of cementum. Current advance technologies for calculus identification include detection-only systems (a miniaturized endoscope, a device based on light reflection and a laser that activates the tooth surface to fluoresce) as well as combined calculus-detection and calculus-removal systems. The present paper focuses on the latest advances in calculus detection technologies.

Keywords: Periodontal therapy, subgingival, calculus

INTRODUCTION

Calculus can be defined as a hard concretion that forms on the teeth or dental prostheses through calcification of bacterial plaque (Glossary of Periodontal Terms 2001). Depending on its location calculus can be classified as supragingival and subgingival.

Calculus is primarily composed of calcium phosphate salts covered by an unmineralized bacterial layer. It mainly consists of dicalcium phosphate dehydrate, octacalcium phosphate, hydroxyapatite and tricalcium phosphate.

Schroeder (1969) concluded, “Initial damage to the gingival margin is presumably due to immunological and or enzymatic effects caused by microorganisms of the plaque. This process is enhanced by the formation of supragingival and subgingival calculus, which provides further retention and thus promotes further plaque accumulation. Calculus itself does not cause pocket formation but in turn favours and promotes the chronicity of inflammation and thus contributes towards making it progressively worse.”

Current advance technologies for calculus identification include detection-only systems (a miniaturized endoscope, a device based on light reflection and a laser that activates the tooth surface to fluoresce) as well as combined calculus-detection and calculus-removal systems.

Table 1: Automated calculus-detection technologies

<table>
<thead>
<tr>
<th>Treatment goal</th>
<th>Technology</th>
<th>Device name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus detection</td>
<td>Spectro-optical Technology</td>
<td>Perioscopy</td>
</tr>
<tr>
<td>only</td>
<td>Autofluorescence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Detectar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ultrasound</td>
<td>Periscan</td>
</tr>
<tr>
<td></td>
<td>Laser and Autofluorescence</td>
<td>Keylaser3</td>
</tr>
</tbody>
</table>

Detection- only systems

1) Fiberoptic endoscopy based technology

The idea to modify a medical endoscope for periodontal use has, to date, been realized only in one device (Perioscopy; Perioscopy Inc; Oakland, CA, USA), which was introduced in the year 2000. It consist of fiberoptic bundle surrounded by multiple illumination fibres, a light source and irrigation system. Its miniature nature causes minimal tissue trauma. Fiberoptic system permits visualization of the subgingival root surface, tooth surface and calculus in real time on display monitor (Meissner G, Kocher T, 2011).

Fig 1: Perioscopy uses a periodontal endoscope which is inserted into the periodontal pocket, to detect calculus.
2) Spectro-optical technology

The spectro-optical approach to calculus detection uses a light emitting diode and fiberoptic technology, and is currently used by only one device, the Detec-Tar (Dentsply Professional, York, USA). Detec-Tar involves an optical fiber which recognizes the characteristic spectral signals of calculus caused by absorption, reflection and diffraction of red light (Kasaj et al 2008).  

Diagnodent™ (KaVo Biberach, Germany) makes use of this property of calculus to detect its presence. Calculus and teeth fluoresce at different wavelength region of 628-685nm & 477-487nm respectively. Diagnodent™ involves use of an indium gallium arsenide phosphate (InGaAsP) based Red laser diode which emits a wavelength of 655nm through an optical fibre causing fluorescence of tooth surface and calculus.

Combined detection and treatment devices

1) Ultrasonic technology

Ultrasonic calculus detection technology is based on a conventional piezo-driven ultrasonic scaler. Perioscan™ (Sirona, Germany) can differentiate between calculus and healthy root surfaces. It also has a treatment option that can be used to remove these calculus deposits immediately. This combination of detection and removal mechanism is advantageous since calculus can be removed just by switching the mode from detection to removal. The advantage lies in the fact that relocating the previously located calculus is not necessary.

Working principle of PerioscanTM Perioscan™ is an ultrasonic device that works on acoustic principles. It is similar to tapping on a glass surface with a hard substance and analysing the sound produced in order to find out the cracks that are present on glass. Tip of the ultrasonic insert is oscillating continuously. Different voltages are produced due to changes in oscillations depending on the hardness of the surface. Hardness of the calculus differs from the hardness of the tooth surface. This difference in hardness can be used to generate the information of the surface that is being touched by the device.

This instrument is used in two different modes. Whenever ultrasonic tip touches the tooth surface a light signal is displayed on hand-piece and actual unit. Light signal is also accompanied by an acoustic signal.  

During calculus detection mode, the instrument shows a blue light when calculus is present. Once a Healthy root surface is attained, green light is displayed when the ultrasonic tip touches healthy cementum. Different power settings aid the clinician in removing tenacious calculus. The only clinical information available for this device has stated a sensitivity of 91% and specificity of 82% (Meissner et al 2008).

REFERENCES