SHORT COMMUNICATION

TeethBioForm: Device for bacterial biofilms formation
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Abstract
In order to efficiently treat and prevent biofilm infections, the understanding of bacterial attachment and development in solid substrates as human tooth, for example, has received a lot of attention in recent research. Nowadays several in vitro models have been proposed for biofilms formation. The TeethBioForm™, developed by the authors, allows the growing of a mature biofilm within shorter periods of time.

Introduction
The development of pulpal and periapical diseases are always related to the presence of microorganisms, and it is of paramount importance for clinicians in endodontics, the understanding and control of those infections.[1] Soon after bacteria have gained access to the complex root canal system, they are organized in communities known as biofilms.[2] The main strategy of bacterial survival is the aggregation in microcolonies. These colonies, also known as biofilms, provide a safe microenvironment to the microorganisms that confer resistance to the action of antibiotics and biocides.[3] However, the studies of environmental microbiology have reported bacterial aggregation since much longer before and have then considered these microbial structures as an important issue affecting microorganisms’ behavior.[4] The classic example is the observation of aggregated bacteria in the “scurf of the teeth” by Anthony van Leeuwenhoek in 1684, which refers to the “dental plaque” development, later corroborated by many dentists. In medicine, the first significant observations linking the etiology of persistent infections to biofilm formation were reported in the early 70s in lung infections of patients suffering from cystic fibrosis.[5]

In order to efficiently treat and prevent biofilm infections it is crucial to understand how microorganisms attach, grow, and develop to mature biofilms in the human body. In recent years, several in vitro models/systems have been proposed for biofilm studies. These models were capable to clarify important matters related to biofilm behavior such as physiology, antibiotic resistance, biocide efficiency, and many other aspects related to surface phenomena associated bacterial development.

The current in vitro methods for biofilm formation on teeth propose soaking the samples in the culture medium, a medium that needs to be changed several times during the experiment. The TeethBioForm™ (TBF) uses a continuous flow of culture medium which is continually renewed. The operator may also add more culture medium or other fluid, such as antibiotics and antimicrobials, without any interruption of the process of biofilm growing. Moreover, connecting the container to a peristaltic pump enables the control of the flow rate of culture medium or any other desired fluid.

The TBF is produced with hermetically sealed and transparent acrylic, presenting a tray for accommodation of the material and two bases in transparent acrylic. Each measuring 7 cm wide, 8 cm high, and 1.5 cm thick. An entryway to the culture medium (or other fluid) is connected to a path and subsequently to an exit, which enables a continuous supply of fluid to the samples attached to the trail. The tray has 12 slots designed to accommodate samples, each measuring 1 cm long, 3.3 cm wide, and 1 mm deep. Each slot is 1 cm distant from the other [Figure 1]. These measures may be adjusted according to the purpose of the experiment and type of specimen (teeth, metal implants, and catheters are used in medicine and/or dentistry). The device is bound to a peristaltic pump and one or two containers that can store the fluid (open or closed system).
The device allows the use of any growing medium of interest, liquid or fluid. Enrichment media may be used, in order to increase the amount of bacterial load of a given clinical specimen or transport media. Selective media may also be used, in order to select target species to be recovered, and to prevent the development of other “undesirable” microorganisms. The device also enables the use of differential or indicator media, allowing the distinction between various genera and species of microorganisms. Figure 2 shows a surface of dentin human block infected with *Enterococcus faecalis* after 16 h in TBF with a continuous flow of culture medium Tryptic Soy Broth.

In addition, to the benefits described above, the use of the TBF allows the growing of a mature biofilm within shorter periods of time compared to the static regime. Previous studies have shown that the greater velocity, the higher is the Reynolds number and the mass transfer of liquid to the biofilm, increasing their rate of development. [6,7]

**References**
