

## ***Biofilms up close and personal . . .***

### **Introduction:**

Bacteria rarely live alone but are organized into multicellular communities that form protective barriers against the body's immune defenses. Like a coral reef, these single celled organisms attach to one another and secrete a matrix that connects and protects them from the outside, while at the same time providing channels for delivery of nutrients. It is believed that most chronic ear infections and chronic sinus infections contain biofilms, and that many are, in part, due to the presence of biofilms.

### **Are biofilms common?**

Yes.

- Dental plaque, the thick white debris that accumulates on and between teeth and at the gumline at the junction between the gum and each tooth is a biofilm.
- In the nose and facial sinuses, “boogers” are biofilms of dried mucus and microbes.
- In the tonsils, the small yellow stones that accumulate in the pits and cause bad breath (halitosis) are biofilms.
- On the eyelids the oily secretions with bacteria within it is a biofilm.
- Stones that are formed in the salivary glands, gallbladder and kidneys, are biofilms.

### **Why are biofilms so hard to treat?**

Most antibiotics work by disrupting the production of key elements for cell growth, or by lysing (popping) the cell during multiplication

and division. In a biofilm, the cell is rarely dividing, but is either resting, or is participating in the activity of the community, producing polysaccharides and glycoproteins to protect the community, transporting nutrients, or providing other functions. These activities are not inhibited by common antibiotics. Moreover, the matrix itself protects the bacteria from antibiotics.

In this protected micro-environment, the bacteria can reproduce and grow slowly, relatively resistant to most antibiotics.

### *What is the treatment for oral biofilms?*

Mechanical cleaning is the most important method to treat oral biofilm growth. Brushing and flossing teeth can remove some of the biofilm formation. Ultrasound cleaning and scaling with sharp metal instruments by the dental hygienist is the most effective way to remove dental biofilms (plaque).

### *Why have I never heard of biofilms?*

Most of what scientists have learned about bacterial diseases was a description of planktonic bacteria – bacteria that are freely floating as individual cells that can be examined under a microscope and grown in Petri dishes. Until the 21st century, we really did not have the tools or understanding to fully describe the complex communities of biofilms, which are generally attached to a surface and too diverse to be considered a “pure” culture.

In the 19th century, Robert Koch postulated that a disease-causing organism should be present in disease states, but not in health, grow in a pure culture, and cause disease when introduced to a healthy individual. With these postulates in mind, culture techniques over the past 150 years have been designed to isolate and replicate single free

floating bacteria, not to analyze a community. The difficulty in that approach is that it is like trying to describe the ecology of the African Savannah by breeding a single captured wildebeest that has strayed from the herd.

*What is on the horizon?*

With 21st century molecular analysis of biofilms, we can now identify numerous bacteria in a single sample, and even calculate the relative contributions of each species, regardless of whether they can grow easily in a Petri dish. Scientists now have the tools to extract and identify small particles of DNA and to know with certainty “who was at the scene.”