

Literature Review of External Influences on the Oral Microbiome

Deep Modi, Faculty Mentor: Dr. Kevin Garey, PharmD, MS

Introduction

The oral microbiome is the second most diverse microbiome in the body. This micro-biodiversity is a result of continuous microbial development in the oral cavity. Despite the constant exposure to the environment, the diverse microorganisms in the oral cavity maintain a delicate homeostatic balance. Eventually, without proper care and precautions, opportunistic pathogenic bacteria can become prevalent and cause dental complications. This shift in bacterial composition within the oral cavity is often influenced by various external factors such as dental procedures and a person's lifestyle². A common denominator in many of these oral infections are biofilms. Biofilms, which are sprawling communities of closely knit microorganisms, are commonly seen in the oral cavity and allow various pathogenic bacterial species to thrive.

Objective:

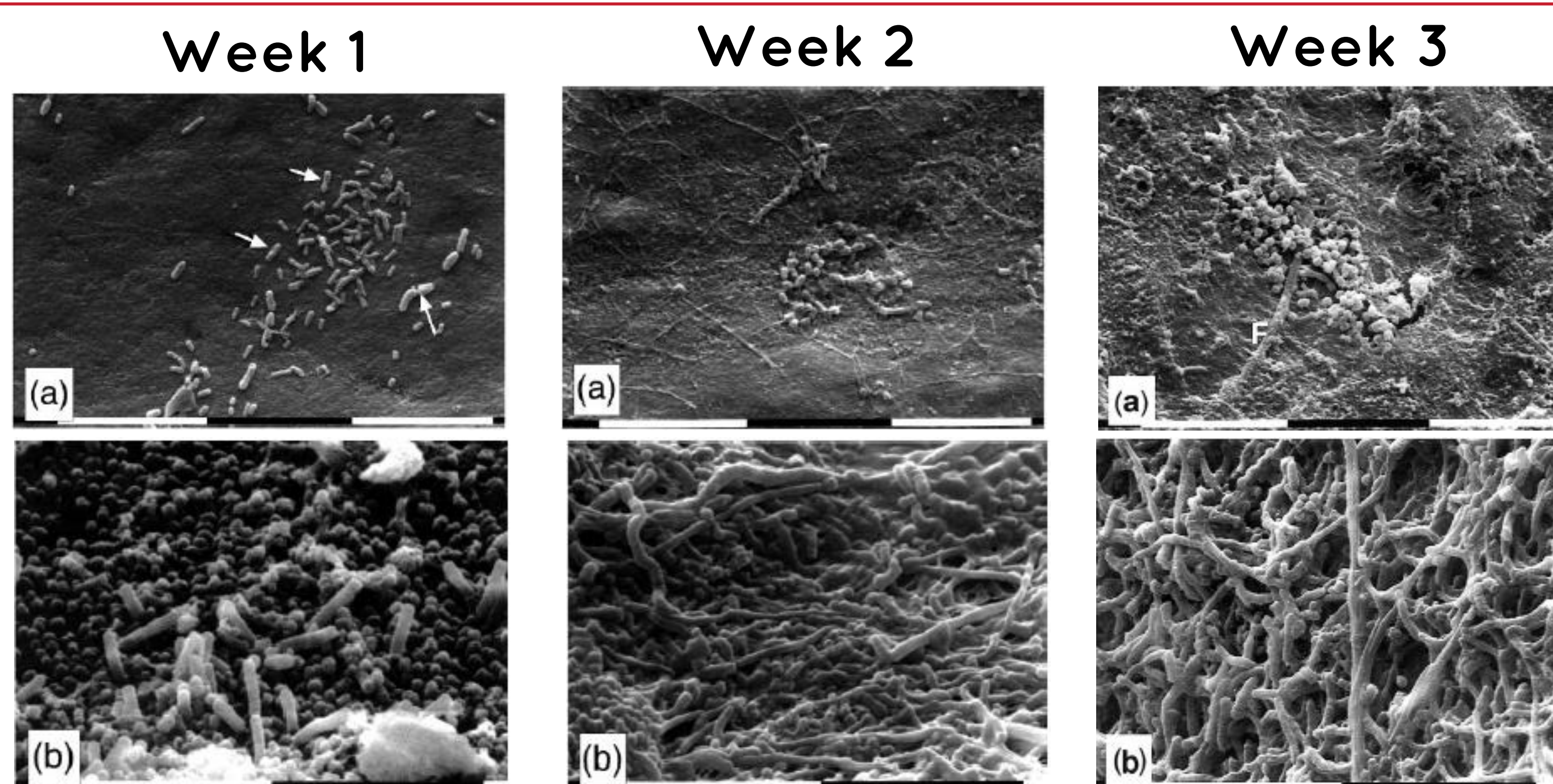
Observe the impact external influences (such as dental procedures) have on the oral microbiome composition and how that may impact biofilm development.

Results

W. Sukontapatipark et al₃:

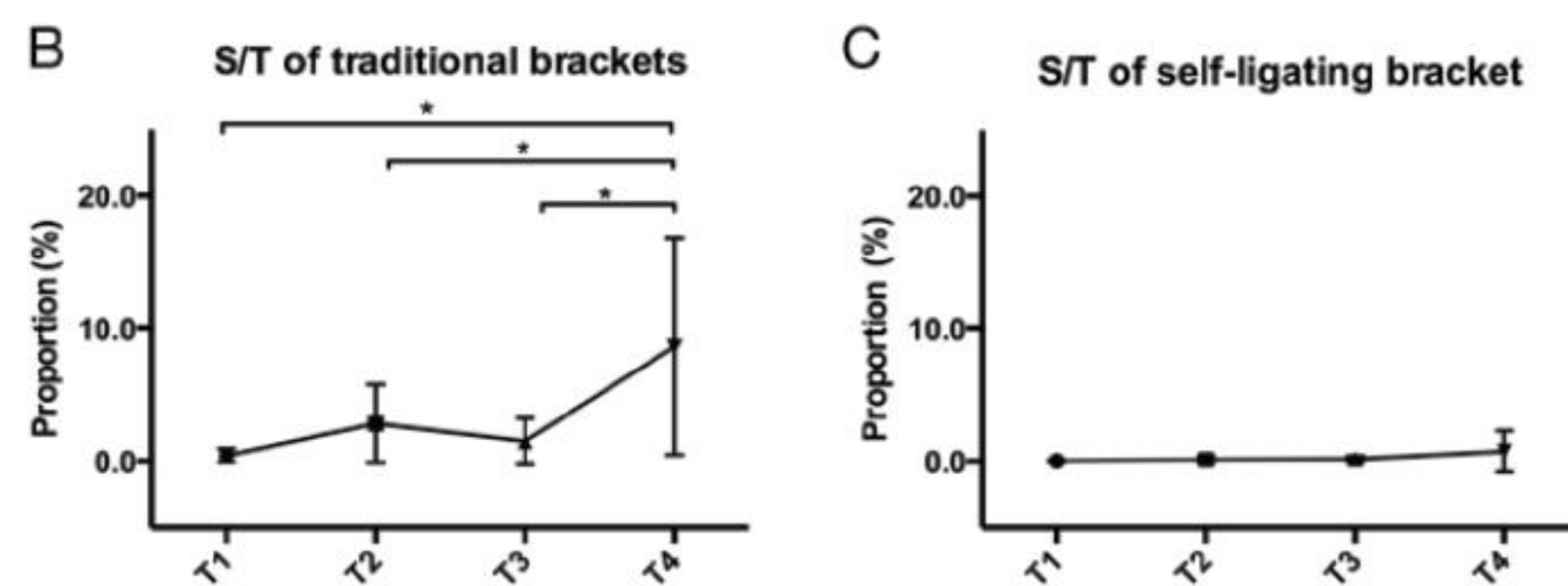
This study looked at the bacterial buildup on subjects with braces over a 3-week period. By comparing the enamel surface with the excess composite (using SEM), the study was able to show the impact of braces on the oral microbiome. Even in a relatively short time, the composite surface saw a large amount of plaque (biofilm) and bacterial growth.

(a)- enamel surface at magnification x2500
(b)- excess composite surface at magnification x3600



Jing et al₄:

This study analyzed the relationship between braces and the presence of pathogenic bacteria over 18 months. More specifically they looked at the relationship between *Streptococcus Mutans* and total bacteria (S/T). Ultimately, the type of orthodontic treatment can impact the degree to which pathogenic bacteria can be found in the oral microbiome.



- Orthodontic treatments have the ability to dramatically and rapidly alter the oral microbiome composition.
- Qualitatively, orthodontic applications such as braces have also shown correlation with increased levels of anaerobic pathogenic bacteria such as *Streptococcus Mutans*.
- The type of orthodontic device (wire ligature vs. removable, etc.) also plays a role in the presence of pathogenic bacteria within the oral cavity.

Discussion

Orthodontic treatments can dramatically alter the oral microbiome composition. This is primarily due to the potential for biofilm formation in the form of dental plaque at and around the bracket. Qualitatively, it is easily seen how over a very short amount of time bacterial/biofilm matrixes can form to a relatively advanced stage. This coupled with the fact that anaerobic pathogenic bacteria (such as *S. Mutans*) were seen in greater concentration of individuals with braces shows the role biofilms play in negatively altering the oral microbiome during these treatments. In a "healthy" oral microbiome, these pathogenic species are not seen predominantly as it would be hard for an anaerobic species to thrive in an oxygen rich environment. Biofilms have the ability to "shield" such species allowing them to grow within the oral cavity. Furthermore, the increase of pathogenic bacteria is also dependent on the type of treatment with removable braces showing considerably less pathogenic bacterial presence than traditional braces⁵. Ultimately, given how prevalent orthodontic treatments are in society, the influence of braces on microbiome composition should be considered.

Conclusion

There are many external influences that can dramatically alter the oral microbiome composition. Orthodontic treatments (such as braces) are an example of such an influence.

- Braces can allow for plaque buildup (biofilm formation) to rapidly occur within the oral cavity. The degree to which this occurs is dependent on the type of treatment a person receives.
- Development of biofilms also allows for an increased presence of anaerobic pathogenic bacteria that cause many dental complications.
- The increase of pathogenic bacteria is also dependent on the type of orthodontic the patient receives.

Next Steps

To truly understand the impact these microbial changes have on oral health, it is important to gain a greater understanding of biofilms and their resilience. This can be achieved through directly comparing the antibiotic resistance of oral planktonic bacteria and oral biofilms. Through this comparison a greater understanding of biofilm characteristics that can facilitate the growth of oral pathogens can be understood.

References

- 1- Aas JA, Paster BJ, Stokes LN, Olsen I, Dewhirst FE. Defining the normal bacterial flora of the oral cavity. *J Clin Microbiol.* 2005;43(11):5721-5732.
- 2- Scheie AA. Mechanisms of dental plaque formation. *Adv Dent Res.* 1994;8(2):246-253.
- 3- Sukontapatipark W, el-Agroudi MA, Sellisetth NJ, Thunold K, Selvig KA. Bacterial colonization associated with fixed orthodontic appliances. A scanning electron microscopy study. *Eur J Orthod.* 2001;23(5):475-484.
- 4- Jing D, Hao J, Shen Y, Tang G, Lei L, Zhao Z. Effect of fixed orthodontic treatment on oral microbiota and salivary proteins. *Exp Ther Med.* 2019;17(5):4237-4243.
- 5- Lucchese A, Bondemark L, Marcolina M, Manuelli M. Changes in oral microbiota due to orthodontic appliances: a systematic review. *J Oral Microbiol.* 2018;10(1):1476645.

Contact Information:

Email: dbmodi@uh.edu